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ELECTRIC LIGHT ASSOCIATIONS.

Note is made elsewhere in this issue of the first convention of the new Pennsylvania Electric Association. It will be seen that this body, which was addressed by President Eglin, of the National Electric Light Association, has decided to become a state branch of that organization. It seems likely that similar action will be taken in other states, thus giving the national body a wider basis of support and influence, while none of the local bodies will sacrifice its real autonomy and independence. In other words, this method of affiliation insures harmony of action throughout the field on all great questions, and puts back of any local body the weight of the national body in times of difficulty and trouble. We are glad to note, also, that in furtherance of the Doherty plan adopted at the Chicago convention, the Commonwealth Edison Company of Chicago has established a company branch with a good membership. We understand that a similar movement is on foot at Rochester, N. Y., and trust that the number of company branches may increase, thus bringing within the sphere of the work of the National Electric Light Association a very large proportion of the personnel of the industry. It is highly essential for the welfare of the association that it should comprise not only the men who stand between a company and its stockholders, but those who stand between the company and its customers.

VALUATION OF LIGHTING SYSTEMS.

The statement of Mr. Henry L. Doherty in relation to the valuation of lighting systems to furnish a basis for rates was made in Wisconsin with particular appropriateness, as the Railroad Commission of that state has been engaged in valuing public utility properties. Valuations have been made in that state both for purposes of taxation and under the authority conferred by the public utilities law. The last report of the Railroad Commission refers to the use of expert engineering services in the physical valuations and periodical revaluations of the operating properties of the electric lighting and other utility corporations of the state, indicating that the purpose of the commission is to continue to make such appraisals. The figures outlined by Mr. Doherty in that portion of his paper which was published in the issue of Aug. 15, page 352, will surprise many persons who have never had experience in the construction of plants. People who have not been interested in building lighting plants, however, but who have erected residences or other buildings, will appreciate the vital need for the allowances above the bare cost of the physical property which Mr. Doherty gives. If all of those who talk so glibly of valuation as a remedy for corporate evils could undertake personal experience in building, they would have some comprehension of problems which companies confront. When a new building is erected it is the common experience of the owner to have some grave disappointment. When the contractor who undertakes the construction of a home, for instance, finds that he cannot conform to the specifications if the profit on which he has figured is to

be made, the usual procedure is to save money on the quality of either the material or the labor. As some contractors do business on a very small capital, and are therefore of doubtful responsibility, a contingency which was not foreseen may result in a bankruptcy before the completion of the building, leaving the unfinished structure on the hands of the owners with various mechanics' and other liens representing unpaid claims that must be met. An individual building his own home is sometimes obliged, on account of circumstances of this character, to complete it in somewhat less desirable a manner than he had anticipated.

A public utility corporation, if it is located in a thriving town, faces problems of this nature during each year of its existence. In the initial construction of the plant, however, and in subsequent additions and betterments, it should accept no workmanship but that which will permit the highest degree of efficiency in operation of the property. If mistakes have been made, or contractors are not able, on account of unforeseen circumstances, to fulfill their pledges, the corporation should see that the work is done in accordance with the approved plans. A high quality of engineering ability and careful supervision of all the details of construction are necessary to successful operation if adequate service is to be provided for the wants of consumers. A failure to appreciate that the true cost of building is much greater than the unit value of property will lead to further misconception of the relations which should exist between the public and the utility corporations. If it should ever be clearly and definitely established that the public in this country would not allow the corporations to make a fair interest upon the capital invested in their plants on a reasonable basis, no further investments would be made. If valuations could be whittled down at will by state or other commissions representing the public, many communities that might enjoy desirable facilities would be without them.

Mr. Doherty points out various costs which he considers should be included in a valuation of the physical assets, such as expenses for engineering, contingencies and allowances if the property was built piecemeal. It may be argued that if proper allowance had been made for the future in the early stages of construction it would not be necessary to construct parts of the plant at different times. It can be shown, however, that while a corporation is justified in anticipating to some slight extent the increase in business which will take place under normal conditions, it is not warranted in investing large sums in equipment much before the additional service is required by actual demands of consumers. The advantage of restricting increases in equipment to a point commensurate with the development of the business is that by so doing the company keeps itself more nearly in a position to take advantage of improvements in the art, which are made constantly. The specific figures given by Mr. Doherty appear to relate to a company which had not been in operation for a long period of time, because they contain no special provision for the cost of material which had been scrapped because of obsolescence. An individual who buys or builds an apartment building or home in, say, New York, expects the appreciation in the value of his land not only to offset much of the depreciation in the structure, but to yield a profit in addition which may be realized when sale of the property is deemed desirable. If commissions are to value public utility properties they should admit that a similar appreciation may take care, in many instances, of losses in value which result from changes in apparatus. In both large and small cities substantial buildings are torn down constantly for the sole reason that appreciation in the value of the land on which they stood has been so great that the buildings are no longer of sufficient capacity to yield a fair interest return on the value of the land. Corresponding changes take place affecting public utility properties, and the state should by some process allow as much to the individuals concerned in such properties as is permitted to the individuals who are interested in the land which has risen in value.

The Future of the Tungsten Lamp.

That the tungsten lamp has come to stay until something more efficient is produced is not now to be questioned. It only remains to speculate as to how these lamps will be handled by central stations and contractors in the course of two or three years, when tungsten lamp manufacture has settled down to a normal basis. Central-station managers differ considerably in opinions on this. On the one hand, we frequently hear the idea expressed that the introduction of the tungsten lamp means the end of free lamp renewals for such companies as have been giving them in the past. On the other hand, there are doubtless many operators of the larger companies who agree with the ideas recently expressed by Mr. Alex. Dow, of Detroit, both before the National Electrical Contractors' Association convention and the Michigan Electric Association convention, to the effect that the handling of tungsten lamps will ultimately be taken over of necessity by the central-station companies, just as these companies have in self-defence for the protection of their customers introduced the practice of giving free carbon lamp renewals. This does not necessarily mean that free renewals of tungsten lamps will be given, but that the companies will sell these lamps at a price below that at which the dealer can afford to handle them. In view of the fact that the larger central-station companies have in the main found it advisable in the interests of good service to purchase efficient lamps in large quantities under test specifications, and give customers free lamp renewals to prevent them buying poor and inefficient lamps and blaming the service for poor results, it would seem only logical that ultimately these companies would be forced to control the quality of tungsten lamps placed on their lines in the same way.

The Primary Standard of Light.

Messrs. Waidner and Burgess, in an article appearing in this number, bring forward a new suggestion for realizing a primary standard of light, which is virtually equivalent to painting the Violle standard black. As is well known, Violle proposed to secure a definitely reproducible standard of light by measuring the luminous intensity of a square centimeter of pure platinum at its freezing temperature, which, as mentioned in the article, is near 1765 deg. C., or roughly near 2000 deg. absolute. In the hands of so skilled an experimenter as Violle, this standard appeared to be reproducible to 1 per cent, but when other experimenters took up the work with inevitable changes in the technique, their results showed wide variations. The article points out that the intensity of light emitted from such a source as the Violle standard depends upon three quantities, namely, the surface area of the glower, its temperature, and its surface

condition. The surface area can easily be controlled with precision by using a diaphragm at a safe distance from the molten platinum. The temperature is of great importance, because a variation of 2 deg. C. changes the luminous intensity 1 per cent. Nevertheless, pure platinum probably has a definite freezing point if care be taken to define the technique. The surface condition is the principal difficulty. Platinum absorbs gases readily, and it seems that the least change in the chemical or physical nature of the glowing surface alters the luminous intensity and spectrum distribution.

The article suggests that instead of the surface of platinum at its freezing point, the surface of a black body at that temperature be adopted. There is no such thing, apparently, as a black body, velvet and platinum black only approaching that ideal substance; but, fortunately, the interior of any uniformly heated furnace has been found to behave like a black body; so that if the interior of such a furnace could be viewed at the exact temperature of freezing platinum, the trouble with the surface or nature of that surface should be obviated. This suggestion is certainly ingenious. It leaves, however, the second difficulty—the temperature—rather worse than before, for when the platinum itself was the source, its freezing could be readily observed and the temperature of the source was thus evidenced; but when, not the freezing platinum but some black body near to it is the source, then the question as to uniformity of temperature becomes more important. Experimental results in connection with this plan will be awaited with interest.

THE RELATIONS OF THE MEASURES OF LIGHT AND POWER.

We are all familiar with the fact that the practice of the science of photometry is in a relatively backward state. Ask a number of chemists to analyze independently any ordinary compound, and their analyses may be expected to agree very closely. Ask a number of mechanical engineers to measure independently the horse-power of an engine working steadily at full load and their results may be expected to correspond within satisfactorily small limits. Ask a number of civil engineers to measure independently the volume of soil to be removed in order to cut a canal of given dimensions between two termini and their findings may be expected to conform. But ask a number of illuminating engineers to measure independently the candle-power of an arc lamp and it would be surprising if the different measurements should agree closely. A greater margin of uncertainty and personal equation should, in fact, be allowed to photometric measures than to any others within the scope of industrially applied science. This is for the reason that light is a physiological stimulus, derived through the eye as an organ of perception, and that we have as yet no other measuring instrument of light except the eye.

It might be supposed, however, that the theory of photometry was soundly established, even if the practice were imperfect. It would be quite possible for the theory to be elaborately refined and unassailable, in spite of defective means of putting the theory into effect. But the article by Mr. Carl Hering, on page 621 of this number, points out various weak points in the theory of photometry. Not only are many of the terms in this theory often misunderstood, but they are also imperfectly defined. To add to the confusion, there have been imported into the practice of photometry certain well-meaning units that would be ridiculous if they were not so generally used. For example, as pointed out in the article, the quantity watts-per-candle, as commonly applied to an incandescent lamp, is very generally called its efficiency, with the result that the larger the so-called "efficiency" becomes numerically, the smaller the true efficiency really is. It would be equally confusing and absurd to define the quantity "kilowatts input per horse-power output" of a motor as its "efficiency."

Mr. Hering indicates that the brightness of a luminous source as defined by the Geneva Congress is not to be distinguished from an illumination, or that both are quantities of the same physical kind. The identity of their dimensions was indeed pointed out by Blondel. Although it is important to recognize this identity as indicated in Mr. Hering's article, the use of the special term "brightness of a luminous source" has been found convenient by writers describing the properties of a glowing surface such as the sun, the Violle standard, or an incandescent lamp's filament. The brightness of a source is, in fact, its light flux emitted per unit of normal surface, whereas the illumination of a recipient is its light flux received per unit of normal surface. In a less imperfect system of units one and the same unit might embrace both quantities. In our existing photometrical theory the fundamental quantity is luminous intensity, or candle-power of a point source. The relation of watts, or horse-power, to this fundamental quantity was quite subsidiary. Blondel showed that, in reality, luminous flux was essentially fundamental to candle-power, and that candle-power could only be defined properly with relation to luminous flux. But even luminous flux, as defined by Blondel and the writers following him, was distinct in conception from watts or horse-power, because the same luminous flux as estimated by the eye could be created by different amounts of radiant watts, according to the spectrum distribution.

The article brings out the fact that if Steinmetz's primary standard of light were worked out and adopted, these orders of ideas would be inverted. The fundamental conception of light would be horse-power. From this luminous flux would follow, by the application of physiological constants. One watt of a definite kind of radiant power would give rise to a definite quantity of physiologically perceived light. All of the photometric quantities would, therefore, be definable in terms of power. Finally, the article draws attention to the fact that it would be possible to use the sphere as the unit of solid angle instead of the steradian. If this definition of the unit solid angle were adopted in photometry, the intensity of a point source at any point in space would agree numerically with the flux density at that point. This suggestion opens up a wide field of discussion, because it is questionable whether one unit of solid angle could be adopted in photometry and another unit in other sciences without eventually leading to discord. The suggestion is certainly interesting, as bearing on the place accorded to the unhappy 4π constant in photometrical theory. It seems a great pity that the Lord made the surface of a sphere so awkward a numeric as 4π. Ten units of area would have been so much more convenient. If, however, discussion of the subject can lead to advantageous action, Mr. Hering's article will have done good service in pointing out the need for improvement in the units of photometry.

Hearing on New York City Central Station Rates.

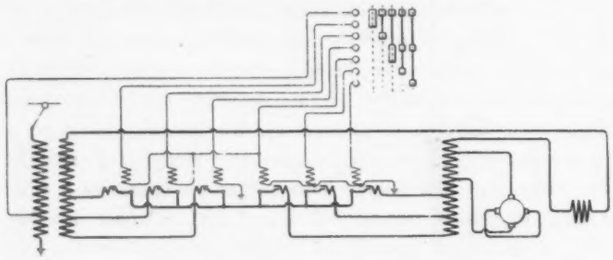
At the hearing, Sept. 10, by the Public Service Commission of the First District of New York into the charges for electric current, Mr. C. G. M. Thomas, second vice-president and general manager of the New York & Queens Electric Light & Power Company, testified that his company had only one special contract, which had been made several years ago and which furnished a large customer with service mainly as an auxiliary to his private plant.

Mr. Thomas said that beginning last May the company had put into operation a regular card rate for lighting, charging 50 cents per month for each 16 cp or equivalent from Sept. 30 to April 30 each year and 25 cents per month for the same service during the other five months. Mr. Thomas said that his company proposed to publish a circular giving full information as to all forms of contracts to all consumers or prospective consumers. Mr. Thomas filed with the commission a new schedule for minimums which his company had adopted. The minimums are: for apartments, $1.50 monthly for primaries and $1 for secondaries; for residences, $2 on primaries and $1.50 on secondaries, not exceeding 50 lights; in residences exceeding 50 lights the minimum is 5 cents per 16 cp or equivalent. The rates for stores are the same as for residences. For public halls, churches and factories the minimum is 10 cents per 16 cp for primaries and 5 cents for secondaries. Mr. Thomas said that his company hoped to be able to finally eliminate all guarantees.

Mr. James E. Phillips, secretary of the Richmond Light & Railway Company, also testified. He said that his company had no special contracts, and that since Aug. 1 one general form of application card had covered all contracts. He said there was one rate for lighting and a smaller one for power; if a customer uses both through the same meter he pays the lighting rate.

Speed Control of Compensated-Repulsion Motor.

The single-phase motor of the compensated-repulsion type with which the names of G. Winter and F. Eichberg have been associated consists of an "inducing" stator winding, a rotor winding provided with a commutator and brushes short-circuiting it on the line of magnetization of the "inducing" winding, and a second set of brushes displaced 90 electrical degrees from the first set and carrying the magnetizing current of the motor. To obtain a "series" characteristic with such a motor, and to regulate its speed and torque, a variable-ratio transformer is usually provided in series with the inducing winding with its



EICHBERG MOTOR CONTROL.

secondary connected to the second set of brushes. As usually applied the number of secondary turns on the transformer is variable. According to a patent issued on June 16 to Mr. F. Eichberg it is preferable to employ an auto-transformer in connection with the motor circuits. As shown in the illustration, the secondary side of the main transformer is connected to switches which are in turn joined to switches connected to the auto-transformer. By this arrangement a double-break in the motor circuit is obtained with single-pole switches. Moreover, the voltage-difference between the several switches is not great, so that they may be mounted in a single casing. Furthermore, all of the switches handle currents of the same amount and they can be constructed exactly alike.

Boston Edison Company's Annual Report.

The Edison Electric Illuminating Company of Boston has filed its returns for the year ending June 30, 1908, with the Massachusetts Gas and Electric Light Commission. The return covers the light districts of Boston, Milton, Dedham, Natick, Framingham, Somerville, Woburn and Medfield, the total number of light customers being 21,719. The total capital paid in is $12,643,600, the total cost of all plant to June 30 being $20,875,413.90. The net amount charged to construction during the year was $1,435,365.95. The cost of the company's plant is as follows:

Real estate	$5,029,478.96
Steam plant	3,174,799.51
Electric plant	3,335,664.05
Overhead lines	2,395,453.03
Underground lines	5,628,143.08
Transformers	270,154.39
Meters	714,833.03
Arc lamps	326,887.85

The total energy manufactured during the year was 88,535,490 kw-hours. The cost of manufacture was as follows:

Coal and other fuel, including expenses of deficit at plant	$409,841.07
Rentals for real estate	19,465.87
Oil and waste	7,348.13
Water	21,667.03
Wages at station	170,393.66
Station repairs	13,521.01
Steam plant repairs	37,269.72
Electric plant repairs	49,774.01
Total	$729,280.50

The net cost of manufacture per kw-hour was 0.822 cent.

The total output sold was as follows:

Street lighting	8,146,501	kw-hours
Metered light and power	35,688,017	"
Energy only by meter, except street railways	11,112,844	"
Railways by meter	677,248	"
Other companies by meter	5,173,996	"
Total	60,798,606	kw-hours

The cost of distribution was as follows:

Wages for care of lights and meters, clerical labor, collectors	$10,511.83
Repair and renewals of lines	165,706.56
Repair and renewals of meters, lamps and motors	44,786.61
Carbons	41,354.04
Incandescent lamps	152,461.53
Total	$414,820.57

Making the distribution cost per kw-hour sold 0.68 cent.

Office expenses and management came to $397,462.16; taxes were $397,584.90; insurance, $60,000; legal expenses, $39,489.69; bad debts, $25,000; incidental expenses, $121,862.59; charged to reserve fund for depreciation, etc., $504,000.

During the year the company burned 102,717 tons of coal at an average cost per ton of each kind used and accounted for of $3.99. The average number of men employed was as follows:

Generating, steam division	136
Generating, electrical division	98
Distribution department	284
Offices and supply department	277
Construction department	49
Transportation department	22
Laboratory department	21
Total	887

The maximum load during the year was 35,511 kw, occurring on Dec. 5, 1907, and the minimum load on the day of least output was 9027 kw, occurring on July 21, 1907. The company's total income from commercial arc and incandescent lamps was $2,896,617.46; from public street arc lamps, $435,610.66; public street incandescents, $91,897.40; making a total lighting income of $3,424,125.52. The income from sale of energy to railways was $40,924.65, and for other uses, $620,324.55. There were allowed no rebates, hence the total income was $4,085,374.72. There was derived from energy sold to other companies $143,864.30, making the total net for electrical energy $4,229,239.02. There was declared in dividends $1,390,796.

Consolidation of Electricity Supply in London.

After several years of Parliamentary fights and of controversy in the technical press it would seem possible that a definite step may be taken before the close of the present year in the direction of putting the supply of electricity in London upon an up-to-date basis. A bill for the establishment of a 120,000-kw power station on the lower Thames has passed the House of Lords and with the support of the government has been given a second reading in the House of Commons. In October it will come before a committee of the House of Commons which, from its constitution, looks as though it might be sympathetic. In addition to this measure, which is brought forward by a new body of promoters, the existing companies have also brought forward a bill for allowing them to link up their various networks and practically to amalgamate their undertakings. Particulars of both the bills have been given in these columns, but technical details of the proposals have only recently become available. As some of these have been worked out with much care and represent the most up-to-date ideas upon the subject of electrical production among British engineers a brief account is presented below.

The bill brought forward by the existing companies authorizing them to amalgamate has had that power deleted from it by the House of Lords, but they are still permitted to link up their networks and give each other supplies in bulk, which they hitherto were forbidden to do. It is doubtful to what extent this interchange of current will actually take place, for, as the following table shows, it would involve a good deal of new plant for transforming the voltage and the periodicity to the various undertakings.

Table I gives particulars of the systems upon which the various companies are at present producing electricity:

TABLE I.

Company.	System of Generation.	Voltage.	Frequency.
Brompton & Kensington Co.	Single-phase	2,000	83
Charing Cross Co., Ltd.	Direct	1,000	..
The Chelsea Co., Ltd.	Direct	200 & 400	..
City of London Co., Ltd.	Direct and single-phase	2,000	100
County of London Co., Ltd.	Direct, single and two-phase	2,000	50
The London Electric Supply Corp.	Direct, single & three-phase	10,500	83
Metropolitan Electric Supply Co., Ltd.	Direct, single and two-phase	200	..
South Metropolitan Electric Light Co.	Two-phase	3,000	50

The more important scheme is that already referred to for the establishment of a large new generating station outside of London altogether, at Barking, a site on the north of the Thames. Here it is proposed to put down a station with ultimately a total plant equipment, on normal rating, of 144,000-kw, or with an overload rating of 180,000 kw. The maximum load on the generating station is estimated to be at that time 120,000 kw, of which 10 per cent, or 12,000 kw, will be expended in transmission and transformation, leaving 108,000 kw as the maximum load delivered to the consumers. A diversity factor of 1.66 is anticipated, equivalent to a total of the maximum loads of the individual consumers 180,000 kw. Particulars of estimates given for two periods, Stage A and Stage B, respectively, are given in Table II:

TABLE II.

Details of the Output of the Undertaking upon Which Are Based the Estimates of Capital, Expenditure, Revenue and Working Expenses.

	Stage A.	Stage B.
Total plant equipment installed (normal rating)	72,000 kw	144,000 kw
Total plant equipment installed (overload rating)	90,000 kw	180,000 kw
Maximum load on generating works	60,000 kw	120,000 kw
Power required for loss in transmission and transformation at maximum load	6,000 kw	12,000 kw
Maximum load delivered to consumers	54,000 kw	108,000 kw
Extent to which the sum of the maximum demands reached by individual consumers at any one time in the year is estimated to exceed the maximum simultaneous load	1.5	1.66
Total of the maximum loads reached by individual consumers at some time during the year	81,000 kw	180,000 kw

As regards the disposal of this 180,000 kw of maximum load it is anticipated ultimately that 105,000 kw will be the maximum load of the bulk supply to existing undertakings, 55,000 kw being direct current and 50,000 kw being transformed to alternating current. Each of these will have a load factor of 30 per cent, giving outputs, respectively, of 144,540,000 and 131,400,000 kw-hours. The amount supplied to individual motor users direct is expected to be a maximum demand of 35,000 kw, which, with a load factor of 25 per cent, will yield 76,650,000 kw-hours, while the railways will require 40,000 kw and have a load factor of 40 per cent. This makes a total per annum of 492,750,000 kw-hours sold or 540,000,000 kw-hours generated, producing a resultant load factor of 53.3 per cent. These particulars are set out in Table III:

TABLE III.

Particulars of Energy Sold.

	A			B		
	Kw.	Load factor, %.	Kw-hours.	Kw.	Load factor. %.	Kw-hours.
Authorized distributers:						
Direct current	27,000	25	59,130,000	55,000	30	144,540,000
Transformed alternat'g.	24,000	25	52,560,000	50,000	30	131,400,000
Motor users	15,000	25	32,850,000	35,000	25	76,650,000
Railways	15,000	35	45,990,000	40,000	40	140,160,000
Totals	81,000		190,530,000	180,000		492,750,000
Units generated (including full load and light load losses in transmission and transformation, *i.e.*, 12%)			216,500,000 kw-hours			560,000,000 kw-hours
Resultant works load factor			41.2			53.3

The capital stock of this station and distribution system is given by the following table:

TABLE IV.

Estimated Capital Expenditure.

	Stage A. Maximum load on works, 60,000 kw.	Stage B. Maximum load on works, 120,000 kw.
Land, generating station, buildings, river work and coal stores	$1,315,000	$2,195,000
Plant at generating station	2,349,550	4,666,850
Transmission and distribution system.	4,937,510	7,635,685
Substations, buildings, switchgear and transforming plant	2,258,300	3,542,315
	$10,860,360	$18,039,850
Engineering, supervision and contingencies, 10%	1,086,035	1,803,985
Preliminary expenses, interest during construction and working capital	1,053,605	1,506,165
Totals	$13,000,000	$21,350,000

The estimated generating costs are given in Table V.

TABLE V.

Estimated Revenue Account.

A.		B.	
To operating costs:		To operating costs:	
Coal 2.5 lb. per unit generated at 12s. per ton	$724,890	Coal 2.3 lb. per unit generated at 12s. per ton	$1,725,000
Water, oil, waste and sundries	25,000	Water, oil, waste and sundries	60,000
Generating works, wages.	51,400	Generating works, wages.	91,170
Repairs and renewals	50,000	Repairs and renewals	100,000
Wages and repairs on transmission system	100,000	Wages and repairs on transmission system	135,000
Management, insurance, rents, rates and taxes.	325,000	Management, insurance, rents, rates and taxes.	826,750
	$1,276,290		$2,937,920
To provision for renewals on basis of: Years of life.		To provision for renewals on basis of: Years of life.	
Buildings 60		Buildings 60	
Plant 25		Plant 25	
Cables 30		Cables 30	
Meters 10	$185,850	Meters 10	$319,225
Total of working expenses	$1,462,140	Total of working expenses	$3,257,145
Net profit	980,755	Net profit	2,458,940
	$2,442,895		$5,716,085

The average price at which electricity is expected to be sold by the time the maximum demand on the station reaches 120,000 kw is 1.112 cents per kw-hour, the cost to the railway companies being 0.8794 cent, while that to the individual user is expected to average 1.336 cents per kw-hour. The actual prices to be charged for bulk supply and for large power users are as follows:

For alternating current untransformed, $15 per annum per kw, plus 0.36 cent per kw-hour.

For transformed alternating current, $15 per annum per kw, plus 0.4 cent per kw-hour.

For low-tension direct current, $22.50 per annum per kw, plus 0.44 cent per kw-hour.

At the present time the cost of producing the electrical energy required for London is $6,939,945 per annum, whereas at the price proposed this energy would cost $3,739,585, showing an

annual saving of $3,200,360. This sum, however, would not be sufficient to meet all the capital charges if the existing generating stations were scrapped, but the idea is that instead of adding any more plant in these generating stations they should gradually take the extra current which they require from the central source.

The generating station is proposed to have six 12,000-kw turbines and to use superheated steam.

First Convention of the Pennsylvania Electric Association.

The Pennsylvania Electric Association held its annual convention at Eagle's Mere, Pa., on Sept. 8 and 9. There were represented 40 companies, including most of the principal electric lighting companies in the state, and at the time the convention was called to order there were about 100 delegates and guests present.

After the reports of the officers and the address of the president were presented, the association discussed the advisability of reorganizing on the basis of a state branch of the National Electric Light Association. The discussion was opened by Mr. Wm. C. L. Eglin, president of the National Electric Light Association, who outlined the scope of the association's work and the amendments made to the constitution and by-laws to allow of the organization of state and territorial branches. The subject was discussed very thoroughly by the various members present, and practically all of the features of association work were treated. The unanimous opinion was expressed that there were no disadvantages in a state association immediately becoming a state branch of the National Electric Light Association, and that the advantages to be gained were along all of the lines of association work. When, later, the question was voted upon, it was unanimously carried that the state association should reorganize as a state branch, and a committee was appointed to carry out the details. Mr. L. H. Conklin, Connellsville, was elected president; Mr. E. F. McCabe, Lewistown, vice-president, and Mr. E. L. Smith, Towanda, secretary and treasurer.

There were also in attendance at the convention a number of representatives of manufacturing companies and supply dealers, and the state branch of the association has arranged for their presence at the state conventions. The program arranged for embraced most of the questions that are of importance at this time, and all of the subjects were freely discussed. The various details of the handling of the convention were excellently managed, and all of those in attendance appreciated the efforts that had been made in their behalf by the officers and committees. The opinion was universally expressed that state conventions are beneficial to the companies and fill a field that cannot properly be covered in any other way.

The meetings were well attended. A brief paper on "The Day of Distribution," by Mr. T. C. Martin, was well received and opened up an interesting line of discussion, particularly on overhead line distribution, a committee being appointed to prepare specifications and instructions regarding proper construction, and to give particular attention to foreign attachments and railroad crossings. A vote of thanks was extended to Mr. Martin for his contribution.

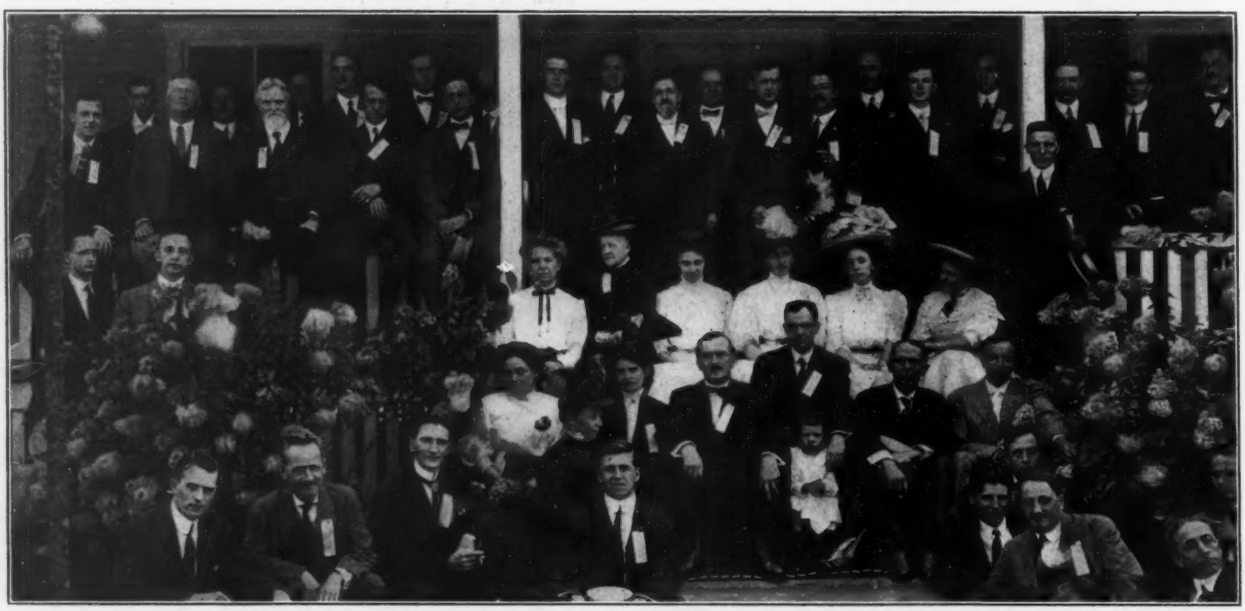
Mr. F. W. Willcox, of Harrison, N. J., presented an interesting paper on incandescent lamps, which opened up a wide discussion on this subject. One of the features of this meeting was the wide and general discussion in which all of the members took part. The discussions were marked by enthusiastic earnestness, which was of great help to all who were present, and indicates a most satisfactory future for the work of this branch.

Amusements and entertainments were provided for the lady guests accompanying the members. One of the enjoyable features in which all took part was a corn roast and camp fire on the shore of the lake. An informal "Glee Club" rendered college songs, and a generally pleasant evening was spent, the success of which was largely due to the entertainment committee. All present appreciated the kindness of the committee and the hospitality that was shown to the ladies by Mrs. Conklin, who was untiring in her efforts.

The program of the convention, in addition to the topics already named, included discussions on the attitude of the association toward state legislation; the advisability of State Commissions; local and state taxation; the capitalization of lighting companies; the fallacies of limited franchises; public liability; local municipal control of the industry; uniform systems of accounting; practical questions of the hour.

A number of members remained over for a day or two after the convention to have an opportunity to talk over their own special conditions. All left looking forward to the next annual meeting and feeling benefited and more fit to go out and solve the problems of the coming year.

A group portrait was taken, which is herewith reproduced, showing many of the members and guests of the new organization.



MEMBERS AND GUESTS OF THE PENNSYLVANIA ELECTRIC ASSOCIATION CONVENTION.

Gilbert's Magnetic Defense of the Copernican Theory.

BY BROTHER POTAMIAN, SC.D., LOND.

Professor of Physics in Manhattan College, New York City.

The great astronomical work, "De Revolutionibus Orbium Celestium" of Copernicus, the Polish ecclesiastic, was published in the year 1543, and dedicated to Pope Paul III. The next year witnessed the birth of one who was destined to champion the Copernican theory in England and defend it with vigor, learning and eloquence, if not with unanswerable arguments and gratifying success. Gilbert, born in Colchester in 1544 (see "The Family and Arms of Gilbert of Colchester," by Prof. S. P. Thompson), studied in Cambridge, where he took his M.A. degree in 1564, and M.D. in 1569. On leaving the University he proceeded to the Continent and spent the four years from 1569 to 1573 in travel and observation. During his peregrinations he visited some of the renowned seats of learning and most famous schools of medicine in Italy, where he met not only physicians and surgeons of great repute, but also leaders of thought in the physical and astronomical world. Conversations with such men were well calculated to beget distrust and disregard for the older views of Ptolemy and to awaken interest in the new doctrine propounded by the Canon of Frauenburg.

Seven years after returning to England, Gilbert gave himself up with ardor to a systematic study of magnetic phenomena, probably with the view of equipping himself adequately to confute the opponents of Copernicanism and of helping to place the modern system of the universe on a firm basis. During 20 years he shunned the glare of society and wrenched himself away from all but the strictest exigencies of his professional duties in order to pursue undistractedly the study of his favorite subjects. The results of this prolonged research, one of the most remarkable recorded in the annals of scientific discovery, are embodied in his epoch-making work on the magnet, which appeared in the century year 1600.

Gilbert expounds his views on astronomy in the last book of his Latin treatise, *De Magnete;* and also in his *De Mundo Nostro Sublunari,* which was published at Amsterdam in 1651, 48 years after his death.

Bacon, the philosophic Chancellor of Queen Elizabeth, was well acquainted with these works of his countryman; indeed, he had in his collection two manuscript copies of Gilbert's "De Mundo Nostro," one in Latin and the other in English, a very singular and significant fact in view of the Chancellor's attitude toward Gilbert. Putting it crudely, one would like to know when and how he obtained possession of these manuscripts, and also what was his motive in keeping them hidden away from the philosophers of the day.

That Bacon was no admirer of Gilbert's physical and cosmical theories the following passages will show. In the "Novum Organum" the Chancellor wrote: "His philosophy is an instance of extravagant speculation founded on insufficient data"; again, "As the alchemists made a philosophy out of a few experiments of the furnace, Gilbert, our countryman, hath made a philosophy out of the loadstone" ("The Advancement of Learning"); lastly, "Gilbert hath attempted a general system on the magnet, endeavoring to build a ship out of materials not sufficient to make the rowing pins of a boat" ("De Augmentis Scientiarum").

One is tempted to ask how this strange disregard which Bacon entertained for the scientific views of the greatest natural philosopher of his age and country came to exist? Was it due to a feeling of jealousy that could not brook a rival in the domain of the higher philosophy, or was it because Bacon, the anti-Copernican, wanted to write down Gilbert, the defender of the heliocentric theory, in the British Isles?

When reading Bacon's depreciatory remarks we have to remember that his mathematical and physical outfit was very limited even for the age in which he lived; from which it is safe to infer that he was but little qualified to pass judgment on the value of the electric and magnetic work accomplished in the workshops at Colchester or on the theories to which they gave rise.

Bacon deserves praise for denouncing the prevalent system of natural philosophy which was mainly authoritative, speculative and syllogistic instead of experimental, deductive and inductive, but he was inconsistent and forgetful of his own principles when he belittled the greatest living enemy of mere book-learning, and the most earnest advocate, by word and example, of the laboratory methods for the advancement of learning.

To avoid misapprehension, it should be here stated that Bacon was not always censorious in his treatment of his illustrious fellow-citizen, for in several places he writes approvingly of the electric and magnetic experiments contained in *De Magnete,* which he calls in his *Advancement of Learning,* "a painfull (i. e., painstaking) experimentall booke." In other places he draws so freely on Gilbert without acknowledgment as to come dangerously near the suspicion of plagiarism.

Gilbert spent 20 of the best years of his life on his researches in magnetism, electricity and terrestrial magnetism. "There is naught in these books," he says, "that has not been investigated, and again and again done and repeated under our eyes." Of his experiments and discoveries, he adds: "We have dug them up and demonstrated them with much pains and sleepless nights and great money expense; nor did we find this, our labor, vain and fruitless, for every day in our experiments, novel and unheard-of properties came to light."

In elaborating his theory of magnetism, and especially his magnetic theory of the earth, Gilbert made extensive use of lodestone-globes, which he called "terrellas," i. e., miniature models of the earth. In pursuing his searching inquiry, he was gradually led from these "terrellas" to his great induction that the earth itself is a colossal, globe-like magnet. Following Norman, "the ingenious artificer," of Limehouse, London, he also showed that the entire cubical space which surrounds a lodestone is an "orb of virtue" or region of influence, from which he inferred that the earth itself must have its "orb of virtue," or magnetic field, extending outward to a very great distance.

Gilbert does not, for a moment, think that this theory of terrestrial magnetism, the first ever given to the world, is a wild speculation. Far from it; he is convinced that "it will stand as firm as aught that ever was produced in philosophy, backed by ingenious argumentation or buttressed by mathematical demonstration."

If the earth has a magnetic field, he argued, why not the moon, the planets and the sun itself, "the mover and inciter of the universe"? Given these planetary magnetic fields, Gilbert seems to have no difficulty in finding out the forces necessary to account for the crucial difficulties of the Copernican doctrine. Nor is the medium absent that is needed for the mutual action of magnetic globes, for we are assured that it is none other than the universal *aether,* which, he says "is without resistance."

Gilbert disposes of the cosmographic puzzle of the "suspension" of the earth in space by saying, and saying justly, that the earth "has no heaviness of its own," and, therefore, "does not stray away into every region of the sky." To emphasize the statement, he continues: "The earth, in its own place, is in no wise heavy, nor does it need any balancing"; and again, "The whole earth itself has no weight." "By the wonderful wisdom of the Creator," he elsewhere says, "forces were implanted in the earth that the globe itself might with steadfastness take direction."

A word in passing to justify our approval of Gilbert's phraseology. If by weight is meant the pull which the earth exerts on a body, then, big and massive as our planet is, it must nevertheless be entirely devoid of weight; for it cannot, with any degree of propriety be said to pull itself. In other words, the earth attracts itself with no force whatever; it cannot produce even an infinitesimal displacement of its mass-center or center of gravity.

It would, however, be correct to speak of the weight of the earth *relatively* to the sun, for the sun attracts the mass of our planet with a definite force readily calculable from the formula mv^2/r where m is the mass of the earth, v its orbital velocity,

and r its distance from the sun. Supplying the numbers, the pull of the sun on the earth comes to be 3×10^{33} tons weight; whereas its mass calculated from the formula $M = 4\pi r^3 p/3$ is 3×10^{21} tons. It may be noted that the velocity v of the earth in its orbit is a varying quantity, depending on distance from the sun. As this is least in December and greatest in June, it follows that the earth is heavier relatively to the sun in winter than it is in summer.

Returning from this digression, Gilbert holds that the daily rotation of the earth on its axis is also caused, and maintained with strict uniformity, by the same prevalent system of magnetic forces, for "lest the earth should in divers ways perish and be destroyed, she rotates in virtue of her *magnetic energy*, and such also are the movements of the rest of the planets."

Just how this magnetic energy acts to produce the rotatory motion of a massive globe Gilbert does not say. Nor was he able to solve such a magnetic riddle, for there was nothing in his philosophy to explain how a lodestone-globe in free space should ever become a perpetual magnetic motor. Oddly enough he disagrees with Peregrinus, who maintained in his famous *Epistola de Magnete*, 1269, that a terrella or spherical lodestone, poised in the meridian, would turn on its axis regularly every 24 hours. He naïvely says: "We have never chanced to see this; nay, we doubt if there is such a movement." Continuing he brings out his clinching argument: "This daily rotation seems to some philosophers wonderful and incredible because of the ingrained belief that the mighty mass of earth makes an orbital movement in 24 hours; it were more incredible that the moon should in the space of 24 hours traverse her orbit or complete her course; more incredible that the sun and Mars should do so; still more that Jupiter and Saturn; more than wonderful would be the velocity of the fixed stars and firmament."

Here he finds himself obliged to berate Ptolemy for being "over-timid and scrupulous in apprehending a break up of this nether world were the earth to move in a circle. Why does he not apprehend universal ruin, dissolution, confusion, conflagration and stupendous celestial and super-celestial calamities from a motion (that of the starry sphere) which surpasses all imagination, all dreams and fables and poetic license, a motion ineffable and inconceivable?"

Gilbert is not clear and emphatic on the other doctrine of Copernicus, the revolution of the earth and planets around the sun. He does, however, say that each of the moving globes "has circular motion either in a great circular orbit or on its own axis, or in both ways." Again: "The earth by some great necessity, even by a virtue innate, evident and conspicuous, is turned circularly about the sun." Elsewhere he affirms that the moon circles round the earth "by a magnetic compact of both." He returns to this point in his *De Mundo Nostro*, saying, "The force which emanates from the moon reaches to the earth; and, in like manner, the *magnetic virtue* of the earth pervades the region of the moon."

We have here an implied interaction between two magnetic fields, rather a clever idea for a magnetician of the sixteenth century. In one case, the reaction is between the field of the earth and that of the moon, compelling the latter to rotate round its primary once every month; and, the second, between the field of the earth and that of the sun, compelling our planet to revolve round the center of our system once every year.

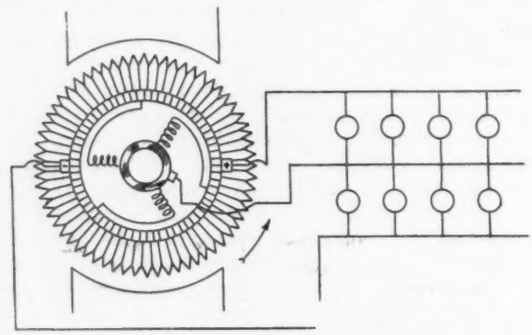
Though an inefficient cause of the annual motion of our planet, this interaction of two magnetic fields had, nevertheless, something in common with the idea of the mutual action of material particles postulated in the Newtonian theory of universal gravitation.

This magnetic assumption by which Gilbert sought to defend the theory of the universe propounded by Copernicus was a very vulnerable point in his astronomical armor which was promptly detected and fiercely assailed by a galaxy of Continental writers; by Cabeo, Kircher, Schott, Grandami, Leotaud, Dechales, De Lanis, Riccioli and Scarella, all of them churchmen, physicists and astronomers of note.* They accepted Gilbert's electric and magnetic discoveries and warmed up to his experimental method; they did not discard his theory of terrestrial magnetism, but rejected and scoffed at the use which he made of it to justify the heliocentric theory. They poked fun at the English philosopher for his magnetic hypothesis of planetary rotation and revolution, and succeeded in discrediting the Copernican doctrine. Error prevailed for a time, but Newton's *Principia*, published in 1687, gave the Ptolemaic system the *coup de grace*. Gilbert's hypothesis of the interaction of planetary magnetic fields gave way to universal gravitation, and Copernicanism was finally triumphant.

*These works are in the Wheeler Gift of the Library of the American Institute of Electrical Engineers.

Three-Wire Direct-Current Generator.

A three-wire, direct-current generator possessing novel constructional features formed the subject of a patent issued on July 21 to Mr. James Burke. The principle of operation and one type of construction are shown in the accompanying illustration. The armature is provided with two separately-insulated windings, which may be designated as the direct current and the polyphase, respectively. The former differs in no respect from



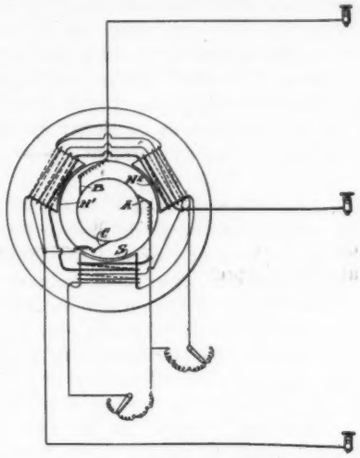
BURKE THREE-WIRE GENERATOR.

the ordinary winding and is connected to the commutator in the usual way. The polyphase winding illustrated is of the three-phase star-connected type, the neutral of the direct-current system being joined to the central point of the star. The three-phase winding is placed in the same slots with the direct-current winding, to which it is connected at three points spaced at 120 electrical degrees from each other. Both of the windings act as direct sources of e.m.f. and there is no transformer action between the two windings or between separate parts of the same winding.

Double-Voltage Direct-Current Generator.

A patent issued Aug. 11 to Mr. J. L. Woodbridge relates to a direct-current generator that delivers two different e.m.fs. from one commutator, each of which can be controlled at will. The accompanying illustration shows a bipolar double-voltage machine. As here shown, the pole S is of the south polarity, while the poles of N^1 and N^2 are both of north polarity. The total magnetic field flux passes through the pole S, but is divided between the poles N^1 and N^2. If this flux is equally divided between N^1 and N^2, the potential between the brushes A and C will be the same as the potential between the brushes B and C. If, however, the division of flux between N^1 and N^2 is not equal, the two potentials above mentioned will be different. The total magnetic field flux and the division of this flux between the poles N^1 and N^2 are controlled by three field windings. One of these windings is wound on all three poles and is connected in shunt between the brush C and the brush A, a rheostat being connected into this circuit for controlling the current in this winding in the usual manner. This winding will control the total flux in the entire field circuit, and with this winding alone the flux would be equally divided between N^1 and N^2. A second field winding is shown wound only on the poles N^1 and N^2, and connected in shunt between the brushes C and A, with a rheostat in circuit. The effect of this

winding is to increase the flux in N^1 and decrease that in N^2, thereby producing a higher potential between the brushes B and C and a lower potential between the brushes A and C than would otherwise exist. A third winding is connected in series between the brush A and the load circuit from this brush, and is so designed that an increase of current passing through this winding will increase the potential between the brushes C and A, and decrease the potential between the



WOODBRIDGE DOUBLE-VOLTAGE GENERATOR.

brushes C and B. By the use of a fractional pitch lap-winding on the armature, it is claimed that satisfactory commutation is obtained. The e.m.f. between brushes B and C is proportional to the sum of the magnetic flux S and that in N^1. Similarly the potential between the brushes C and A is proportional to the total flux in S and N^2. These two e.m.fs. are independently variable.

Lighting at Coney Island's Mardi Gras.

The annual Mardi Gras and fall festival at Coney Island began on Monday night of this week. As is usual, the immense playground of New York was fittingly decorated for the occasion and given over to public revelry and frivolity. The carnival was one of the most spectacular and dazzling pageants given in this country and marked the end of the Coney Island season. Of the 12 floats in the principal section of the parade, three made allusion to electricity, to wit: "From Candle to Electricity," "From Telegraph to Wireless" and "From Horse Car to Subway."

In addition to the usual lighting on Surf Avenue and the special decorative lighting installed on many of the buildings, there were 6000 8-cp incandescent lamps strung diagonally from one side of the street to the other giving the effect of a series of X's with the greatest amount of illumination in the center of the street. The problem of illuminating the floats was solved by the use of a trolley system designed by the staff of the Brooklyn Edison Company. The floats, which heretofore were lighted from storage batteries, were connected through a stage cable with a weighted trolley traveling on wires suspended along the side of the avenue. All of the floats were drawn by horses, and enough cable was used to permit the horses to swerve from side to side.

The float leading the procession and holding the king and queen of the carnival represented an elaborate rococo garden, strewn with flowers and vines. The throne was brilliantly lighted by 600 incandescent lamps hung from beneath the canopy and festooning its supports. The float of lights showed a candle, a lamp, a gas lamp and an electric lamp, all burning and topped with a huge electric lamp. The float showing the progress in building depicted the development from the cottage to the skyscraper, the latter lighted by electricity and showing elevators running. The float representing water travel noted the two extremes in steamship construction from Fulton's *Clermont* to the gigantic *Lusitania*. The dolphins used to ornament the four corners and the ships were brilliantly lighted with electricity.

The float designed to represent local street transportation had an old-time horse car surmounting a modern subway car. The latter was lighted with electric lamps and showed passengers within. The telephone, telegraph and wireless telegraphy float showed operators at work at the keys and at the switchboard. Wireless messages were sent and received by operators made up to represent various inventors.

CURRENT NEWS AND NOTES.

N. E. L. A. BRANCH IN CHICAGO.—In accordance with the new policy of the National Electric Light Association, as adopted at the last annual convention, a branch of the association is being established by the employees of the Commonwealth Edison Company. The branch starts with over 100 members.

NAVAL LONG-DISTANCE WIRELESS STATION.—Lieutenant-Commander Clelland Davis, in charge of wireless telegraph work in the Navy Department, has submitted to the Secretary of the Navy plans for a wireless station on the top of the Washington Monument, by means of which it is claimed communication may be established with warships at any point within a distance of 3000 miles.

CURIOUS LABOR UNION SUIT.—A special cable dispatch from Paris, of Sept. 12, says: "Three Paris music hall singers, MM. Mansuelle, Castel and Pommay, won an extraordinary suit in the courts this week against M. Pataud, who is head of the Electricians' Union. The actors asserted that a strike of electricians on a recent evening made them lose the amount of their pay on that evening, and claimed damages. The judge sustained them, and M. Pataud is forced to pay the damages and costs. The lawyer for the plaintiff declared that M. Pataud had abused the right to strike. The judge agreed with this, and decided as follows: "Pataud, as the delegate of the electricians, has charge of a public service, the members of which have no right to strike any more than postoffice or railroad employees. In ordering a strike of two hours he had not had in view any end to be gained, but a trial of forces. Thus it is necessary to recognize his bad purpose, since it destroyed the economic conditions of a great city for the time being and deprived workmen of the right to work and of their salary." This appears to be a unique decision and rather far-reaching.

NEW YORK ELECTRICAL SHOW.—Active preparations are being made for the New York Electrical Show by the various exhibitors. The Brooklyn Edison Company, which had the "perfect apartment" last year, will show this year the "perfect store" and the "perfect factory," illustrating graphically the application of electricity to industrial and commercial life. The New York Edison Company is to make an extremely interesting exhibit in full working order of electro-mechanical accounting laid out by its auditor, Mr. Edwards. In the section commemorative of the Atlantic cable of 1858, the Commercial Cable Company, through President Mackay and Vice-President Ward, is making a loan exhibit of relics, appliances, maps, models, etc., covering the whole period of submarine cable development. Mr. A. A. Pope, of the New York Edison Company, is preparing a loan exhibit of models, appliances, etc., showing the conditions of electric lighting on Manhattan Island in 1882-3, and contrasting with them the same apparatus, etc., at the end of the quarter century. Mr. T. A. Edison has suggested that a display be made of some of the processes and results of electro-chemistry and electro-metallurgy, and Dr. E. F. Roeber is acting as chairman of a special committee to carry out this excellent idea. Mr. Edison, who is president of this commemorative exhibition, will also, through the National Phonograph Company, show his latest developments in phonographs and moving pictures, all in actual operation. These and a number of other features indicate a show of unusual interest and attractiveness. It will be open at Madison Square Garden from Oct. 3 to Oct. 14 inclusive.

GERMAN-BRAZIL CABLE.—Great satisfaction is expressed in Berlin over the successful conclusion of arrangements for laying a direct cable between Germany and Brazil, crossing the Spanish Island of Teneriffe in the Atlantic, with a branch to the German West African Colony via Liberia. The Brazil port selected as a terminus has not yet been named.

BOND ISSUES HELD UP.—The Public Service Commission of the Second District of New York has reserved decision on the application of the Cataract Power & Conduit Company, of Buffalo, to issue $120,000 5 per cent gold bonds, and on the application of the Westchester Light Company to issue $505,000 collateral trust bonds with which to purchase 8040 shares of the common stock of the Northern Westchester Light Company and 5000 shares of the Peekskill Lighting & Railroad Company.

ELECTRO-THERAPEUTIC MEETING.—The eighteenth annual meeting of the American Electro-Therapeutic Association will be held at the Engineering Societies Building, 23-33 West Thirty-ninth Street, on Sept. 22, 23 and 24. On the evening of the 23d the session will be entirely devoted to a study of the exhibits, which will be held in the large room on the fifth floor adjoining the usual assembly room of the New York Electrical Society. The association has procured the use of the fifth floor for the three days of the session, and the members of the electrical societies, and engineers in general, are cordially invited to be present during such parts of the session which may be of technical interest to them.

LIGHTING IN BALTIMORE.—Mr. W. Darbee, assistant general manager of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., informs us that on Baltimore Street, that city, a scheme of lighting has just been adopted similar to that on Fifth Avenue, New York. It is called locally the "Zigzag" system, and consists of 16 twin arc lamps per block, on each side of the street. The lamps are "staggered," not being directly opposite each other. They are served by underground circuits and are mounted on wooden poles with ornamental twin goose-neck tops. The distinguishing feature about the installation is the intensity of the illumination, there being 18 arc lamps to the block and the blocks averaging about 300 ft. in street length.

GERMAN PUBLIC UTILITIES.—U. S. Consul Norton, of Chemnitz, Germany, notes that in the Empire there are 58 cities containing over 50,000 inhabitants. Of these 44 own and operate gas works, 38 electric light plants, 10 street railways, and 43 water works. It is said that the electrical works clear $4,200,000 annually, less $1,300 for interest charges. The amount of allowance for depreciation is not stated. Mr. Norton says: "The entire capital invested by German municipalities in plants for public utilities is now estimated at nearly $1,000,000,000. The value of forests and meadows, as well as the capital of municipal banks and loaning organizations, is not included in this total. While so much activity in this field is developed by the German cities, there is but little evidence of a tendency to invade indiscriminately the economic territory of general industrial competition. Municipal control is established when there is simply the choice between a public and a private monopoly, as in the case of gas, water, electricity, etc., or else when the desirability of a utility is unquestioned, but the uncertainty as to profitable returns fails to attract private capital. There is but little probability that German municipal enterprise will step outside these limitations."

ELECTRICAL ENERGY FROM PEAT.—A bill is before the British Parliament to authorize the erection of a station at Robertstown, County Kildare, 27 miles from Dublin, for generating electrical energy from peat moss, the peat to be taken from the Bog of Allen. The bill had originally sought the right to supply energy to Dublin and adjacent townships, but Dublin, Pembroke and Rathmines have been struck out. It is said that a number of agreements for the supply of energy have been made, among them being several for suburban street railways. The money required for the enterprise is said to be waiting only for the passage of the bill. In a hearing on the bill a former director of the Manchester ship canal said they had tried gas produced from Irish peat, containing from 50 to 60 per cent of moisture, and found it to be very good. The scheme, he thought, would be a commercial success. One of the engineers of the enterprise stated that the area comprised 847 square miles. Arrangements have been made for overhead transmission. The works they proposed would give 15,000 hp on a 30 per cent load factor. The bill has been strongly opposed by several corporations, including the Dublin Gas Company, on the grounds that the introduction of electricity on such a scale would seriously interfere with its present rights.

WIRELESS ON THE PACIFIC COAST.—Four more radio-telegraph stations will be established in British Columbia before the end of the present year and the Dominion Government is now considering sites upon which to erect these stations. The success of the stations at Cape Lazo, Point Grey, Pachena, Estevan and Victoria, which have been in operation for the past six months, has induced the government to proceed with the execution of the original plan of erecting 10 stations, and the additional four are to be ready for operation before the end of the year. These will include one at Prince Rupert, the Pacific Coast terminus of the Grand Trunk Pacific; one at the northern end of Vancouver Island, and one on Moresby Island in the Queen Charlotte group. An example to the other Trans-Pacific lines has been set by the "N. Y. K." line of Tokio, which has equipped its six steamships of the American fleet with wireless. At present these liners communicate direct with Victoria when 200 miles out at sea. The Pacific Coast Steamship Company's fleet were among the first of the coastwise fleets to be equipped with wireless, and now about 10 of the steamers plying between Seattle and Alaska are provided with facilities. The Canadian Pacific Railroad Company is at present considering a proposition from the United Wireless Company to equip all its vessels, and orders have just been given by the Inland Navigation Company for installations on all the vessels of its fleet. In addition to the big liners a number of smaller coasting steamers have been equipped and in every way the system is proving most popular.

VENEZUELAN CABLES.—Advices from Caracas, Venezuela, state that succeeding President Castro's recent affront to France, when he refused to recognize the Brazilian Minister as in charge of French interests in Venezuela, comes the accusation from the judge of the Civil Court of First Instance of Caracas that high officials of the French government instigated the alleged revolutionary acts of the late French Vice-Consul Quievreux, and that, as a consequence, the Venezuelan government reserves the right to bring what action against the government of France it may deem proper. This statement, threatening new disturbances, and which cannot but still further embitter France against Venezuela, was made by Judge Chimies in his decision in the trial of the French Cable Company for complicity in the Matos revolution, in which he condemns the company to pay the enormous fine of almost $5,000,000, besides large additional damages to be assessed by experts. President Castro probably has small expectations of getting any cash from the French Cable Company, but he is believed to have a very determined desire to get the coast cables in part payment of this fine and as chastisement for the alleged complicity in the revolution. These cables connect all of the principal seaports of the country, and cost almost $1,000,000 to lay. They would be of great strategic importance to the national government, especially in case of revolution. As soon as a revolution breaks out in Venezuela telegraphic communication is constantly interrupted, because it is such an easy thing for the revolutionists and their sympathizers to keep the wires cut. With the coast cables Castro could always maintain uninterrupted communication with all the large ports.

Generating Station of the Borough of St. Marylebone, London.

THE new generating station erected by the Borough Council of St. Marylebone, London, England, is equipped with a steam turbine plant rated at 12,000 kw. The station is built on the banks of the Regent's Canal, which affords every facility for obtaining coal and water and in addition allows of the easy disposal of ashes. The building is a steel and brick structure capable of housing machinery rated at 18,000 kw and is built on an isolated bed of concrete to minimize, so far as possible, the effects of vibration. The main frontage is on Richmond Street.

Coal is brought to the station either in barges or by truck. When brought by truck the fuel is dumped into a chute on the ground level, whence it is carried by a bucket conveyor to another chute at the top of the building. It then falls on to a Robins belt conveyor which runs along the top of the bunkers situated over the boiler room and by the aid of a traveling carriage device it is fed into whichever bunker it is desired to fill. The belt conveyor is propelled by a 10-hp motor and its direction of running is reversible in order that it may be able to deal also with coal delivered by canal at the other end of the building. Here the equipment consists of an electrical jib crane fitted with a grab and situated in an elevated position over the bunkers. The coal is discharged from the grab into a hopper from which it is conveyed upward by an elevator and fed on the belt as before.

The bunkers are built of reinforced concrete and have a capacity of about 3000 tons. From them the coal falls by gravity into Ingrey traveling weighing machines suspended on an overhead rail structure in the boiler room, and after the weight of the load has been registered it is dropped into the hoppers of the mechanical stokers in front of the boilers. The bucket elevators are also used for the disposal of ashes. A tray conveyor runs in an ash tunnel under the boilers and receives the ashes as they fall from the fires and carries them to one of the coal elevators. They are then elevated to either of two 30-ton ash bins situated in the bunker room and from these are discharged into carts or barges for removal.

Water for boiler feed purposes and also for condensing purposes is taken from an artesian well sunk at the north end of the boiler room. A steam-driven, direct-acting pump, capable of dealing with 10,000 gal. per hour, lifts the water from the well into tanks situated on the roof of the boiler house, and the portion used for boiler feed purposes is passed through a Reisart water-softener in order to remove as much of the hardness as possible. In the event of the failure of the pump or well, water can be taken from the mains or from the canal.

The boiler room contains 12 Babcock & Wilcox water-tube boilers fitted with chain-grate stokers. Each boiler is capable of evaporating 18,000 lb. of water per hour into steam at 200 lb. pressure under normal working conditions; but if required this can be increased to approximately 25,000 lb., in the case of four boilers which are fitted with a thermal storage arrangement. The stokers are driven from an overhead shaft operated by three 15-hp motors. The boilers are arranged in pairs, each of which, together with its superheater and thermal storage drums, forms a separate and independent unit. The superheater consists of a nest of steel tubes through which the steam generated by the two boilers it serves passes on its way to the main steam range. Under the tubes is a furnace fed automatically by a chain grate stoker, and by this means an extra quantity of heat is imparted to the steam. On the top of every alternate boiler and connected to it by pipes are two large drums, through which the feed water for the boilers must pass. There is thus always available a large quantity of hot water at the temperature equal to that in the boiler and at times of heavy load this is most useful, enabling the output of steam to be increased to the extent already mentioned.

FIG. 1.—GENERAL VIEW OF ENGINE ROOM IN ST. MARYLEBONE GENERATING STATION.

Following the path of the feed water from the initial stage where the exhaust steam from the condensers is turned into water, it is first pumped out of the condenser by air pumps into the hot-well. The boiler feed pumps are connected on the suction side to this well and deliver water at a pressure slightly above that in the boilers to the economizers. The feed pump equipment is in duplicate. Each feed water set consists of a

Hall compound steam pump rated at 10,000 gal. per hour and a Simpson three-throw plunger pump to deal with 15,000 gal. of water, electrically driven by a 35-hp motor. There are four

33 hp and 65 hp they will deal with 60,000 and 100,000 cu. ft. of gas per minute. Sanders Rehders draft recorders are fitted to each battery of boilers and a number of CO_2 recorders are

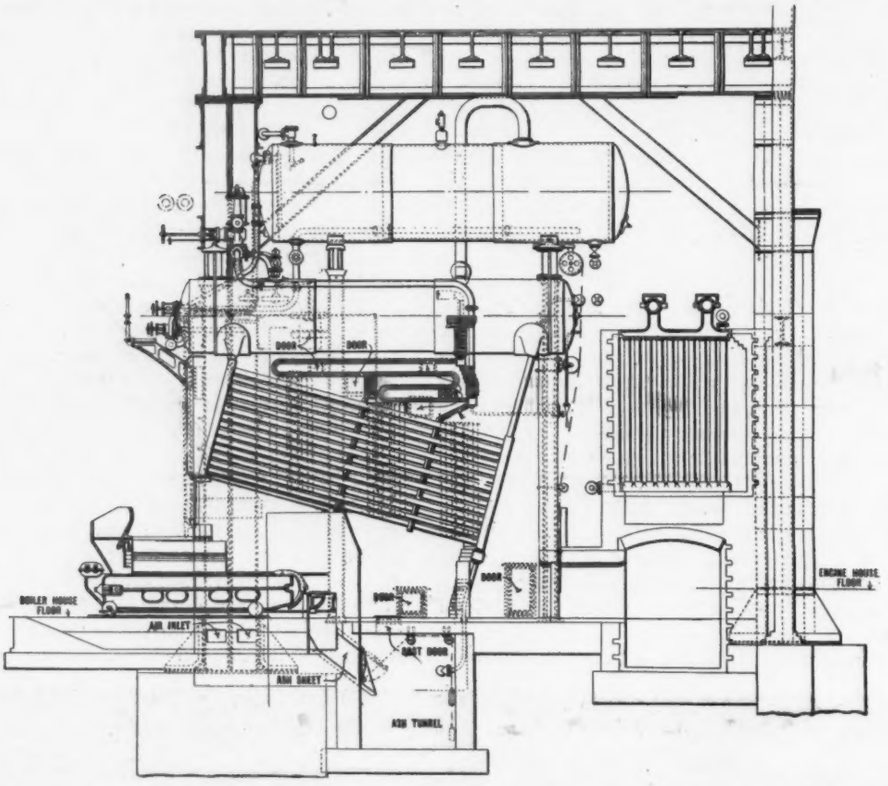


FIG. 2.—ELEVATION OF BOILER SHOWING THERMAL STORAGE DRUM, ECONOMIZER AND MAIN FLUE.

economizers of the well-known Green type placed on the top of the main flue behind the boiler. The economizers contain 1720 tubes, which are kept free from dirt by a series of scrapers driven by electric motors.

Normally each chimney serves six boilers and three superheaters; but it is possible to work any group of boilers on either chimney. Induced draft fans are installed at the base

provided to keep a check on the chemical composition of the flue gases.

The engine room, which is lighted in an unusually effective manner, is equipped with five 2000-kw turbo-generators and

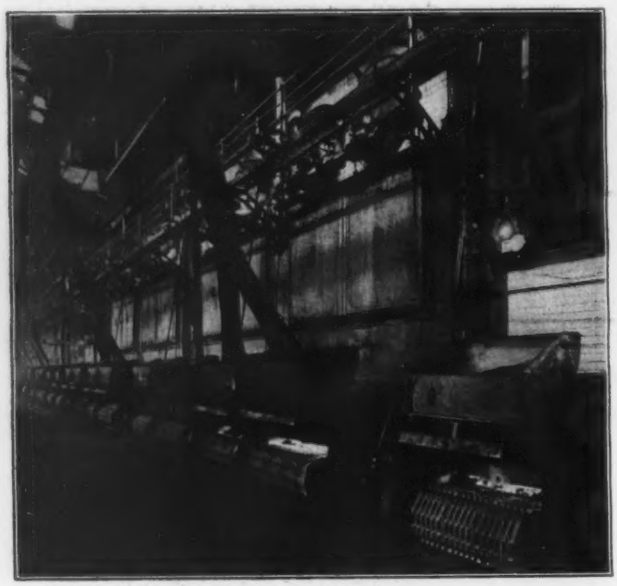


FIG. 3.—GENERAL VIEW OF BOILER ROOM.

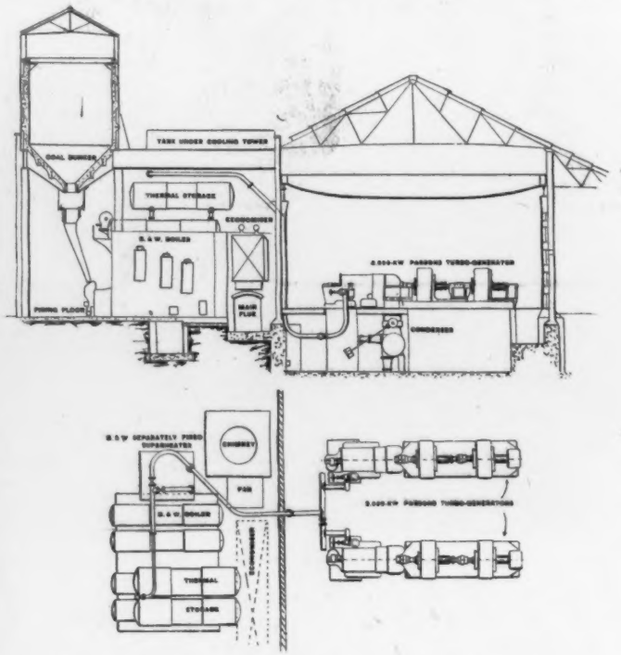


FIG. 4.—ELEVATION AND PLAN OF ONE BOILER AND TURBO-GENERATOR UNIT.

of each shaft. There are in all four fans, which are direct-coupled to electric motors. Two sizes of fans are installed, 48-in. and 60-in. diameter respectively, and when these absorb

four 500-kw turbo-generators. These are fed with steam from an underground steam-piping system. Each turbine and its two generators are placed on a heavy concrete bed adjacent to

the base of which under the floor is the condenser equipment. The turbines were built by C. A. Parsons & Company and are guaranteed not to consume more than 20 lb. of steam per kw-hour in the case of the larger sets and 21 lb. per kw-hour in the case of the smaller sets. The units are capable of running at 25 per cent above rated output for one hour and will deal effectively with a 50 per cent temporary overload. Steam is supplied at the stop valves at a pressure of 200 lb. per square inch. The speed of the large turbines is 1200 r.p.m. and the speed of the small turbines is 3000 r.p.m. The generators are of the four-pole semi-enclosed type fitted with fans for forced ventilation. The five large units are wound for a pressure of 500 volts and are connected across the outer wires of the three-wire system. These generators supply the greater part of the load; the function of the smaller sets, which generate at a pressure of 250 volts, being that of balancing the network.

The air pumps and circulating pumps of the condenser equipment are motor-driven, the arrangement of the equipment being shown in Fig. 6. The circulating water is used over and over again through the agency of two cooling towers. These cover an area of 80 ft. x 30 ft. and 70 ft. x 30 ft. respectively on the roof of the boiler house. Each tower is equipped with eight 32-hp motor-driven fans for creating a draft through the center of the tower structure. The towers are of the wooden slat type and each is capable of reducing the temperature of 440,000 gal. of water per hour from 100 deg. Fahr. to 80 deg. Fahr.

For the purpose of providing a stand-by supply of electricity for the motor-driven auxiliaries, the station lamps, and the milking booster in the engine room, the function of which is to charge any one cell of the battery that may require it. This booster is portable.

The station has two switchboards, one at the north end and the other at the south end of the engine room. While there is little difference in the equipment of each, the board at the north end of the engine room is the principal one, the other being practically an extension to it. The north switchboard is divided into three sections, in connection respectively with the positive, negative and neutral wires of the distribution system. Four main busbars run horizontally along the back of the two former sections and the generator and feeder cables are each connected to one of the vertical bars conspicuous on the front of the panels. These are put into electrical connection with the busbars by plugs, the handles of which project from the front of the board; and by this means it is possible to run any machine on any feeder or group of feeders, thereby allowing four different pressures to be supplied to as many feeding points in the streets. The feeders are allotted 17 panels on the positive and

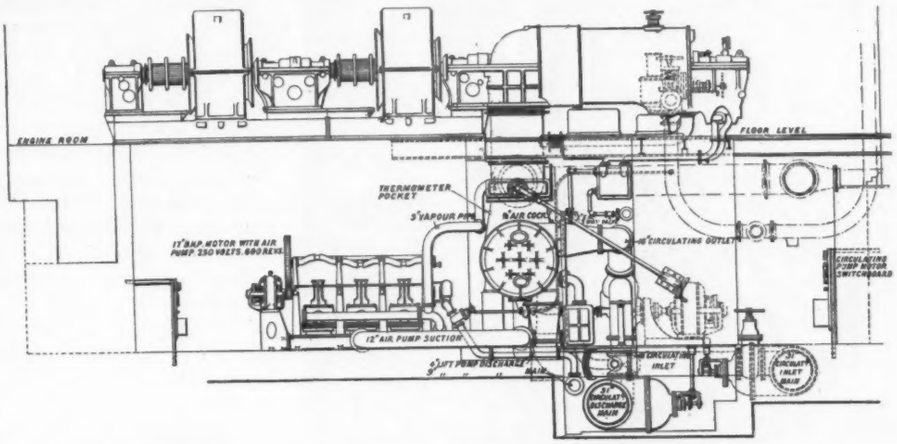


FIG. 6.—ELEVATION OF 2000-KW GENERATING SET, SHOWING CONDENSERS, PUMPS, ETC.

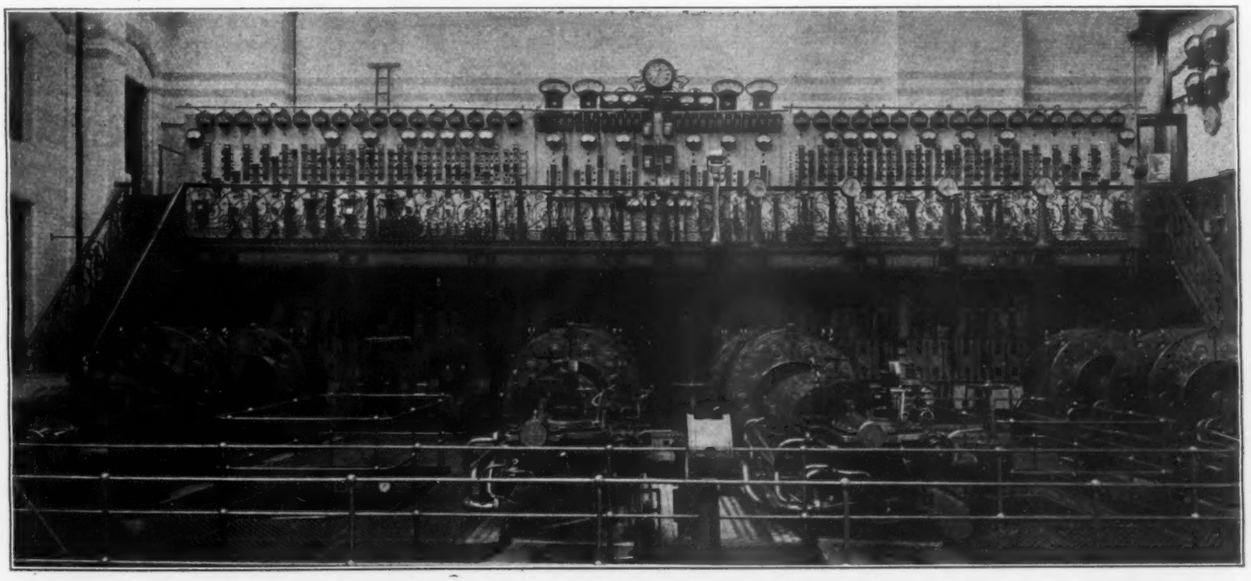


FIG. 5.—VIEW OF THE NORTH SWITCHBOARD AND STEAM BALANCER SETS.

excitation circuits of the generators, a 500-amp hour, 250-cell battery is provided. In connection with this battery is a combined booster-balancer set placed under the north gallery, the motors of which help to balance the load on the network to the extent of 200 amp and also drive the two boosting dynamos used when charging or discharging the battery. The latter are designed for an output of 500 amp at any pressure from zero to 100 volts in either direction. There is also a small negative sides and six for the neutral or third wire. The feeders, of which there are 28 positive, 28 negative, 6 neutral and 2 power, are controlled by single-pole knife switches and fuses, the latter being mounted separately on panels below the gallery.

By means of signaling instruments on the front of the switchboard gallery, at the turbines and in the boiler room, the engineer in charge can control the working of the entire station.

With a view to keeping down the running costs to a minimum a bonus scheme is in operation under which a percentage of any reduction effected is shared out half-yearly in certain proportions among the men.

The old generator stations of the company at Aybrook Street, Manchester Square and Rathbone Place have been converted into battery substations. Each substation is equipped with a battery having a total rating of 3000 amp-hours and in addition

FIG. 7.—PART OF MANCHESTER SQUARE SUBSTATION BATTERY ROOM.

the Manchester Square substation contains a small 100-volt, 1000 amp-hour battery used in connection with such consumers as the Council supplies at 100 volts. Fig. 7 shows a part of the main battery room of the Manchester Square substation, the 100-volt battery being at the far end and half of the 3000 amp-hour battery in the foreground. The other section of the battery is placed in an adjacent building and the booster and switchgear are placed in another part of the building. Fig. 8 shows the balancer-booster sets and the switchboard in the Manchester Square substation.

There are 24 trunk feeders running from the generating

FIG. 8.—INTERIOR OF MANCHESTER SQUARE SUBSTATION.

station to the feeder pillar boxes illustrated in Fig. 9. The feeders are of the paper-insulated, lead-covered and armored type laid direct in the ground. Of the 123 feeder pillars erected in the streets of the borough, the trunk cables monopolize 21, of which 10 are arranged to feed 12 distributors and 11 subfeeders. The remaining 102 are three- and four-way subfeeder pillars.

The house services are taken off the distributors by means of special tee boxes and may consist of either two or three wires. An ordinary small installation is connected to one side only of the distributing system; but an installation of over 25 amp is split, half being placed on each side of the three-wire system. Motors up to 3 hp in size may be connected to one side of the system and hence may be wound for 240 volts; but all motors above 3 hp in size must be wound for 480 volts.

In the matter of street lighting the Council has shown some energy. Oxford Street from Marble Arch to Tottenham Court Road is lighted by 81 flaming arc lamps of the Excello type, rated to burn 16 hours and to consume 10 amp at 480 volts when connected nine in series. The lamps replace 122 gas lamps and are for the greater part arranged two on each standard in the center of the road and 25 ft. above it. After midnight alternate lamps are switched out of circuit.

The publicity and canvassing work of the company is under the supervision of a commercial engineer who is responsible to the resident engineer and manager. From three to eight canvassers are employed according to the time of the year and the amount of work on hand. Canvassing operations are carried out upon a system entailing a complete record of all calls and negotiations. Each of the representatives makes a short daily report of all his calls, which is handed to the commercial engineer for perusal and filing. The report is then dissected by a clerk experienced in the work and whenever the results of

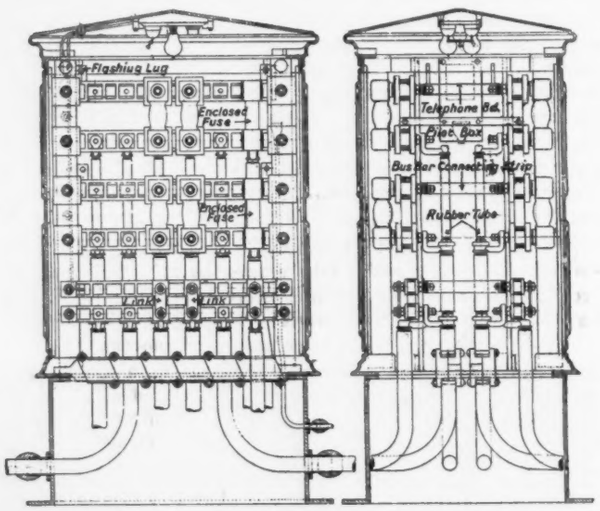


FIG. 9.—ELEVATION OF SIX-WAY TRUNK FEEDER PILLAR.

a call warrant it, an extract of the report is made on a card allotted to the address in question and filed in a special card index cabinet. By this means the progress in any particular case may be seen at a glance and a new man can take up the work with an exact knowledge of the acts of his predecessor. Commencing with an entry recording a more or less point blank refusal, the extracts go from date to date, gradually becoming more favorable until finally, perhaps in nine months after the call, the sought-after "application signed" appears.

Promiscuous canvassing is not encouraged. The department has always a list of "possibles" at hand contributed to by both the distribution and the secretary and accountant's departments, and upon this the greatest amount of work is centered. A system is also in use by which the commercial engineer's department is advised of every application form for supply taken, or sent, from the offices. If these forms are not returned signed after a few days, a representative calls in order to clear up any difficulties that may have arisen. The department has numerous scrapped gas engines to its credit. Much systematic circularizing is carried out and in addition the department maintains a well-equipped show room in which are exhibits covering the whole field of electricity. A bonus system is also worked in connection with the canvassing staff to encourage it in its work. The consulting engineer for the system was Mr. Arthur Wright.

On the Relations of the Measures of Light and Power.

BY CARL HERING.

AT the recent Atlantic City convention of the American Institute of Electrical Engineers a very interesting and valuable paper was read by Dr. C. P. Steinmetz on a "Primary Standard of Light,"[1] in which he proposed a novel and very ingenious method of establishing a certain rational, definite and reproducible composite unit of light to be defined in terms of the power (or rate of energy) represented by, or equivalent to, the light; and to take as the unit that amount of this light which is equivalent to one watt. This enables light to be expressed and measured in any power units like watts and horse-powers, and therefore indirectly also in terms of units of work (energy) like foot-pounds per second, calories per second, ergs per second, etc. The novel and more important feature is the ingenious method of composing and producing the light itself, and to enable lights of different colors to be compared and measured; the other feature, namely, representing light in power units, and making the unit of light numerically equal to a power unit, was suggested before.[2] Radiant light is a quantity of the same order as power; it is a true form of power and the equivalency of light and power units therefore naturally suggested itself. The difficulty was to define the nature of the light which was to correspond to one watt; the earlier suggestion was to specify a certain single or average wave length, but this was acknowledged to be not entirely satisfactory. Dr. Steinmetz's method seems to overcome this difficulty in a very complete way, and the realization of this long desired rational unit of light now may become possible. For convenience in referring to it I will in what follows call this one-watt unit of light flux a "steinmetz," as it is at least as creditable a proposition as the "violle" was. It would not be good policy to refer to it as the one-watt unit, as watts imply something electrical and might readily be confused with the electrical input of power which is at present enormously greater than the output of light in watts; a clear distinction between these two kinds of watts is of course very important.

The discussion which followed the reading of that paper indicated that the various different units involved in the measurement of light, their true physical meaning, and the relations between them, are not yet generally understood and that some confusion and looseness of expression and terms still exist. In view of the possible realization of such a standard, it may be of interest to review briefly the various light or photometric units and quantities, and their relations with each other, as also the relations involved in this equivalency of light and power, in order that they may be more corectly understood, and incidentally to prevent if possible the introduction into our nomenclature of more such incorrect and indefinite statements as "watts per candle," the indefinite meaning of which can be taken to improper advantage.

The term light unit or unit of light is as general and indefinite as the term electrical unit or magnetic unit. Just as there are a number of electrical units or quantities like volts, amperes, ohms, watts, etc., each of which is absolutely distinct and different from the others, so there are a number of light units or quantities which are just as distinct and different from each other. No electrical engineer of to-day would confuse volts with amperes, yet light units which are quite as different and distinct from each other are often confused. This is partly due to the fact that there is no rational system of light units in common use and there are no generally accepted specific names for all of them, although such a system and such names were suggested semi-officially some 12 years ago, but have come into use only to a very slight extent by careful writers who realize the importance of the distinction between them. Many efforts have been made to get those names into general use and to have the distinctions between the different quantities more generally understood and recognized, but with apparently little success. Recently, however, the subject of light has been receiving more careful, intelligent and systematic consideration, and this good work will be greatly facilitated by the use of a rational system of specifically named units and by a more general and a clearer understanding of the various different quantities involved in what might be termed "Light Engineering," or "Illumination Engineering."

In general this subject of the various measures of light deals with three typical kinds of sources of light, (1) a light issuing in conical beams from what may be considered as a point, as in the case of almost all our commercial lamps, to which the well-known law applies that the illumination is inversely as the square of the distance; (2) beams to which this law cannot be directly or conveniently applied, as in the case of daylight, a parallel beam from a projector, sunlight, moonlight, etc.; (3) a large surface from which light issues, too large to be considered a point, like a large white wall, a long tube lamp, a large phosphorescent surface, a large ground glass which transmits light, a surface of molten metal, etc.; whether it is an original source or whether it is diffusely transmitted or reflected light does not concern its measurement, as in all cases we can consider the surface itself to be the source. The measurement of light furthermore deals with quantity of light, its intensity, illumination produced by it, etc. Also with color, absorption, the physiological effect on the human eye, effect in the camera, etc., but these latter are beyond the scope of the present notes.

The Geneva International Congress of 1896 specified and adopted five different quantities or measures and their units, with names for some of them, in terms of which light is expressed or defined and measured, namely, intensity, flux, illumination, brightness of source and quantity of light.[3]

In order to get a clearer idea of their true meaning and of the relations between them, let us consider first the three important ones—intensity, flux and illumination—the other two being readily disposed of later.

Intensity is the best known of them and the usual unit is the standard candle, or the hefner. It refers to sources of light like most lamps, from which light radiates in approximately conical beams, as though issuing from a point; it refers only to such sources and to no others. It expresses the degree of the light-giving power of such a source, or in other words it refers to the intensity of the source when this source may be considered as practically a point, as distinguished from daylight, bright walls, long tubular lamps, etc. It is this unit which has heretofore been and is at present the only fundamental unit of light from which all others are derived. It should be clearly understood that it is a measure of intensity only, and nothing else; it does not measure the amount of light radiation, the illumination, the so-called "brightness of the source," or the quantity of light. It is of course possible to measure some of these other quantities indirectly by means of this intensity, if the other factors involved are in some way eliminated, just as we can measure volts indirectly in the usual voltmeter by measuring the amperes of current flowing through the instrument, the other factor, resistance, being eliminated by having it the same during calibration as during subsequent use. Voltage, though often measured by current, is nevertheless a distinctly different quantity.

Intensity or candle-power is a quantity which is incommensurate with power or rate of work, hence it is not possible to express one directly in terms of the other, that is, to give an equivalent between them, just as it is impossible to give an equivalent between pounds and feet, or amperes and volts; they have different dimensions, as the mathematical physicists call it. Hence the well-known expression "watts per candle" for an efficiency is physically incorrect, and a loose expression of something else, as will be shown below. Therefore, if a unit of light is to be expressed and measured in terms of watts, it cannot be the unit of intensity or candle-power One watt of

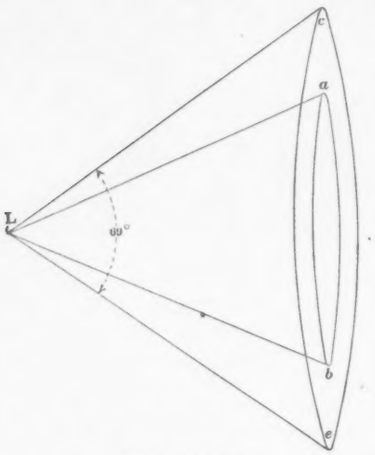
[1] *Proceedings* of the American Institute of Electrical Engineers, March 1908, p. 297; discussion ibid. July, 1908, p. 1359, and in reports to be published of the Atlantic City convention.

[2] Conversion Tables. Hering. 1904, pp. 3 and 147.

[3] A complete description of these with all their values, conversion factors and inter-relations will be found in Conversion Tables, Hering, pp. 144-149.

light radiation can generate an infinite number of different candle-powers; if for instance L in the illustration is a source of light radiating one watt of light, and if the whole radiation is confined first to the small angle $a\,L\,b$, and then to the larger angle $c\,L\,e$, its measured candle-power will evidently be much lower in the second case than in the first, although the watts of light radiation are the same in both cases; if it were radiated evenly in all directions, like from the center of a sphere, the candle-power would be very much less.

Referring again to the illustration and remembering that the angles in such cases of radiation from a point are solid angles, like the point of a cone, let us assume for the same of simplicity that the larger area $c\,e$ is twice the smaller one $a\,b$ (hence the larger solid angle is twice the smaller, assuming the surfaces to be spherical); then it is evident that when the same radiation (power) is distributed through the larger angle, its in-



SOLID ANGLES.

tensity measured anywhere along its paths is just half as great as when it is confined to the smaller angle. Hence for the same amount of radiation (power) the intensity varies inversely as the solid angle, and for the same angle it varies directly as the radiation, that is,

$$\text{intensity or candle power} = \frac{\text{radiation}}{\text{solid angle}}$$

and therefore

$$\text{radiation} = (\text{candle power}) \times (\text{solid angle})$$

that is, candle-power must be multiplied by a solid angle before it represents power. Radiation being a true power is a quantity of exactly the same nature as watts, horse-powers, etc., and can therefore be expressed and measured in terms of watts, or other power units, just as meters can be expressed in terms of feet.

Among the various units or measures of light, therefore, the amount of radiation is the one and the only one which can be correctly expressed or measured in watts. It, therefore, forms the connecting link between our light units and our other units, just as energy (work) is the only measure which is common to the electrical, mechanical and thermal units or measures, and is the only connecting link between them.

Light radiation is known as *flux of light*, which is the second one of the above units. Hence it is flux of light and not candle-power, illumination or any other measure of light, that is measurable in watts, and in Dr. Steinmetz's proposal he therefore starts with flux instead of candle-power as the fundamental measure of light and makes its unit the watt. Intensity or candle-power then becomes a derived unit instead of the fundamental one, as it was and unfortunately still is at present.

Light flux or radiation is a unit or quantity which is unfortunately not so well understood or as commonly used as candle-power and illumination. It is a more fundamental quantity than candle-power, as the latter is really a derived expression for the density of the flux, as will be shown later. Hence it is more rational to start with flux, that is, power, or energy per second, as the fundamental quantity and then derive the candle-power from it, instead of the reverse, as we have been doing. It would even be still more rational to go back still further to energy (work) as the basic fundamental quantity, because power is itself really a derived unit, being energy divided by time; but with light as with electricity used commercially, we almost always have to deal with power and seldom with energy, that is, with watts instead of joules; hence it would be unnecessarily awkward and burdensome to go back to energy as the fundamental, when the power unit answers all purposes and is far more direct.

Our present common unit of flux is the spherical candle-power, and when we use the latter term we are really designating a quantity of flux, although not calling it by that name. The semi-official unit is called the lumen[1], which is the quantity of flux radiated in a unit of solid angle called a steradian. Flux, however, need not necessarily radiate from a point; it may be any other form of a beam of light, as, for instance, a beam of daylight; hence it can exist without necessarily involving any specific candle-power, which latter term refers only to a specific case of flux. Flux can, therefore, be used to express and measure all beams of light, including such as those from the sky, from projectors, from a bright wall, from a large surface of phosphorescent material, from lamps in the form of long tubes, etc.

The relation between flux and candle-power has already been given above in a different form; it is

flux (or power) = intensity (or candle-power) × solid angle.

This, therefore, involves the solid angle, which is what we mean when we speak of "spherical" or "hemispherical" candle-power. In order to get quantitative relations between flux and candle-power we must, therefore, decide what unit to use for the solid angle; a solid angle is one like that at the point of a cone. The real unit for measuring solid angles is that angle which subtends a unit of area at a unit distance from the apex, as, for instance, a square meter at a distance of 1 m; such an angle would be represented by a circular cone having a plane angle at the apex of about 69 deg. Such a unit angle is approximately represented in the figure. There are about 12½ (accurately 4π) such angles in a sphere, which latter is the largest possible solid angle. The sphere may therefore also be used as a unit for measuring solid angles; we use the sphere as that unit when we speak of spherical candle-power, while in the semi-official unit lumen the real unit angle is used. A conversion from the one to the other requires a multiplication or division by the quantity 4π. The question of which of these two angles would be the better to use will be taken up later. The equation for solid angles is

$$\text{solid angles} = \frac{\text{surface}}{\text{distance}^2}$$

The *density of luminous flux* is an important quantity, but it will be shown below that it is really represented (unfortunately under different names) by the units of candle-power and those of illumination, which are, in fact, units of flux densities.

The third important measure of light is *illumination*. It is generally conceived to be a measure of the brightness of a body on which a beam of light falls and which is illuminated thereby, being, therefore, a secondary source of light. This is only a specific case, however, as its real meaning is much broader and more general. It really expresses or measures what might be called the specific brightness of any beam of light whatsoever, whether it be, as is more usual, that of a beam of light falling on a surface, like a reading table, the walls of a room, etc., or reflected from such surfaces, or transmitted through them (ground-glass window or photometer screen) or issuing from a source like the sky, clouds, a long tube lamp, a large phosphorescent surface, a surface of molten metal, or even the surface of a carbon filament, or a gas flame, a Welsbach mantle, etc. It really represents the amount of light flux per unit area, irrespective of whether it is a prime source, like a lamp, or a secondary source, like daylight or a white wall from which light

[1] Conversion Tables. Hering. Page 147.

is reflected, or of the beam itself, whether it falls on a beam or not. It is, therefore, in fact the flux density of a beam of light, even though not generally so considered, and is equal to the total flux divided by the cross-section of that flux. The name "illumination" is, therefore, an unfortunate one, being badly chosen and at times quite misleading. It is the unit in terms of which the brightness of all such direct or indirect sources of light can be expressed and measured, as those just mentioned above, which do not issue from a point. It can be, and frequently is, used also with sources issuing from a point or lamp. It is, therefore, a unit which is quite analogous to that discussed above called the intensity measured in candle-powers. Both are true *measures of flux density.* Intensity (in candle-powers) is the more convenient to use when the beam is conical; that is, when the light issues virtually from a point or from a lamp, because then the beam has no one definite cross-section, as its cross-section increases with the distance from the source; hence the flux density obtained by dividing the flux by its cross-section (that is, in illumination units) is not a constant by which it can be expressed, unless the distance from the source is also given. But the solid angle of such a conical beam is a constant for such a beam, and therefore by designating the cross-section in terms of this angle, which is quite as definite a designation of the boundary of the beam as its cross-section would be, then the flux density of such a beam becomes a constant. As was shown above, candle-power or intensity is equal to flux divided by the solid angle, hence it is really the flux density, referred to the constant angle, even though it is not generally so considered.

Intensity in candle-powers and illumination (so called) are, therefore, really quantities of the same kind in so far as both are true measures of flux densities; they ought both to be called intensity or flux density, the one the "intensity in candle-power" and the other "intensity in foot-candles (or other illumination units)"; in some cases the one and in other cases the other is the more convenient; illumination is the more general as it applies to all cases, though less conveniently to conical beams, while intensity is the more convenient for such beams and, in fact, is limited to them.

The two quantities are, however, not physically identical, as the one involves a solid angle and the other a surface. The relation between them, which, of course, can apply to conical beams only, is the well-known one

$$\text{illumination} = \frac{\text{intensity (in candle-power)}}{(\text{distance from source})^2}$$

This enables us to calculate either from the other. Hence, it makes it possible to express and measure the intensities of such lights as daylight, light from a white wall, or from a long tube lamp, in candle-powers, if there is any object in doing so. For knowing the numerical value of the illumination, the equivalent in candle-powers is obtained directly from this formula after assuming some specific distance; hence, the intensity of daylight or of a white wall can be correctly stated to be *equivalent to* so-and-so many candle-powers at such-and-such a distance. This distance is generally assumed to be 1 m or 1 ft., in which case the intensity in candle-power units is, of course, numerically the same as the illumination in units of illumination (in our present system), no calculations being required.

If we were concerned in practice only with illumination, we might abandon the consideration of intensity in candle-power altogether. But flux of light (that is, spherical candle-power) is that which we buy and pay for, while it is a matter of choice with us whether we then want to produce with it a bright illumination over a small surface, or a less bright one over a larger surface, the seller of the light is not responsible for this; he is responsible only for the amount of light flux (usually stated in spherical candle-power) which his light will give us per dollar of cost. Hence for commercial reasons we must get back to candle-power if we want to express the flux of light in spherical candle-power as we do now. We would, of course, quite correctly designate a lamp by stating that it gives so-and-so many "steinmetz" or watts of flux of light, without referring to candle-power; this is similar to expressing it in spherical candles, as we do at present; "steinmetz," watts and spherical candles are all units of the same kind and are interconvertible. We could thus eliminate the term candle-power, but this would involve a somewhat revolutionary change in our methods, which I fear it would be hopeless to try to bring about.

It is important to understand clearly that neither candle-powers nor illuminations in any way represent or involve any definite amounts or quantities of light; they represent only the density or intensity of light and have nothing whatever to do with its quantity any more than a specific gravity or density represents any particular quantity of a metal. To speak of buying and selling candle-powers of light or foot-candles of illumination is absurd and would be taking improper advantage of the ignorant. It would be like selling volts or pounds of steam pressure. Something more must be specified, unless it is clearly understood what the omitted quantity is. In the case of light it is the flux; but flux alone is not sufficient, its intensity must be stated, too, or else it may deceive and not answer our purpose at all; just as watts alone are not sufficiently specified for commercial use unless the voltage is also stated, or steam without a statement of its pressure. And such flux ought to be (though often it is not) clearly stated in terms of definite units so as not to deceive. For instance, the "mean candle-power" is often stated so as to imply a flux of that many *spherical* candle-power, when it may really represent hemispherical units and the purchaser then gets only half the amount of light which he pays for.

For the same flux the illumination varies inversely as the surface, and for the same surface it varies directly as the flux. Hence the relation between illumination and flux is

$$\text{illumination} = \frac{\text{flux}}{\text{surface}}$$

this surface being, of course, that on which this quantity of flux falls or from which it issues or through which it is transmitted. This enables either to be calculated from the other. If, for instance, 10 units of flux or 10 watts of flux, to use Dr. Steinmetz's new unit, issue from a long tube lamp, or from a white wall, or enter as daylight through a window, or come from any definite surface, then the numerical value of the corresponding illumination of that surface (or intensity, as I should prefer to call it) will be 10 divided by the surface, being careful to use the same unit for the surface as is involved in the illumination unit; if the latter is in foot-candles, then the surface must be stated in feet. Or, if the illumination and the surface are known, the flux can be calculated from them. From either the flux or the illumination can be calculated the candle-power of a source which at a certain assumed distance is equivalent to it. In this way it becomes possible to compare with each other numerically any two sources of direct or indirect light and to give their equivalents, provided we can measure any one of these three quantities, and always provided there are no material color differences, as that is a subject by itself which is separate and distinct from the subject of the inter-relations of the units.

The simplest way to measure a light is the usual way of measuring its mean spherical candle-power, say, by revolving it before a photometer or by other well-known methods. This, however, applies only when the source is small enough or can be removed far enough off to be considered as a point source. This gives its mean candle-power and the total flux in spherical candles. From the latter and the area of the source, the "illumination" of its surface (or surface intensity, as I should prefer to call it) can be calculated if desired. A moderately long tubular lamp could thus be completely specified. If the source cannot be treated as a point, nor have its flux measured by its spherical candles, then the illumination of its surface or in a cross-section of a beam, must be measured and the flux and candle-power calculated from it, if desired.

The difficulties lie with the numerical values of the units. Our common unit of illumination is the foot-candle; that is, that from one candle at 1 ft. The semi-official unit is the lux, or meter-hefner, which is that from one hefner candle at 1 m; or when calculated by dividing the flux by its cross-section it is

one lumen per square meter, which is equal to the other (lux). But flux is measurable in watts, hence this measure (illumination) is of the nature of watts per square meter or per square foot.[1] In the new system this unit would be 1 watt per square meter of $1 \div 4\pi$ (or 0.07958) watt per square meter, depending on which of the two systems is used, as will be shown below, where they are compared. In our present system the unit is $1 \div 4\pi$ (or 0.07958) spherical candle per square foot, which is equal to one foot candle; hence, the simple equation given above must with our present units be modified to read:

$$\text{illumination in foot-candles} = \frac{4\pi \text{ flux in spherical candles}}{\text{surface in square feet}}$$

and the one for flux becomes:

$$\text{flux in sp. cand.} = \frac{\text{illumination in ft. cand.} \times \text{surface in sq. ft.}}{4\pi}$$

Illumination, although obtained by dividing flux by a surface, is, of course, itself independent of surface, in the sense that if the illumination of a certain surface is stated to be so-and-so many units, it applies to any surface whether large or small; that is, surface enters into the calculation of illumination only when the latter is calculated from the flux; by itself a specified illumination does not involve the extent of the surface, hence the size of the beam or of the photometer screen on which the radiation proposed by Dr. Steinmetz falls, would be immaterial, provided only that the illumination is at the rate of 1 watt per square meter.

The remaining two measures of light specified by the Geneva Congress are not important. The *"brightness of the source"* which is stated to be the quotient of the candle-power divided by the surface of the light-giving source, is, in the writer's opinion, an irrational and hybrid unit and ought not to be used. The candle-power unit is based on the conception of a radiation from a point which has no dimensions, hence this unit of brightness is like specifying the number of points per square millimeter. The writer considers this quantity, namely, the specific brightness of a source, to be a quantity precisely like illumination and is correctly and directly measurable in units of illumination like foot-candles or luxes. The brightness of a white screen would be measured and correctly expressed in the same units whether it is illuminated from in front, giving off reflected light, or from the back, giving off transmitted light; in the latter case it can correctly be considered a source of light like the surface of a hot carbon filament or flame, only that its "illumination" is numerically much smaller than that of the latter. There is no good reason why different units should be used in the two cases.

The last unit is *"quantity of light,"* which is equal to flux multiplied by time; the semi-official unit is the lumen-hour, that is, one lumen of flux used for one hour; our common unit would be spherical candle-hours. It is the rational unit in terms of which light ought to be bought and sold. It is exactly like hp-hours or watt-hours, and, in fact, is a unit of exactly the same order and is interconvertible with these. With Dr. Steinmetz's new unit as a basis, the unit of quantity would be numerically equal to one watt-hour, or 3600 joules.

This unit or measure is, in fact, energy (work) as distinguished from power, because flux × time is like power × time, which equals energy. Hence, it is convertible into foot-pounds, watt-hours, calories, joules, ergs, etc. It might, therefore, have been chosen as the fundamental unit of light, as energy is a more fundamental unit than power. The natural unit would then be the erg or joule or watt-hour. But, as was described above, it would seem to be taking a long way when there exists a short cut; it is of theoretical rather than of practical interest.

The common term "efficiency in watts per candle" is an unfortunate one, and careful writers should not use it. It is like speaking of kilowatts (power) when one means to say kw-hours (energy). It gives the impression that there is an equivalent between watts (power) and candle-power (which is not power at all, but a flux density). To be correct it should be "watts per spherical candles," because watts and light flux (*spherical* candles) are interconvertible. It is presumably well known that "watts per candle" is not a measure of an "efficiency" at all, but exactly the reverse, namely, an inefficiency. The correct measure of efficiency is "spherical candles per watt" or "steinmetz per watt," the watt here referring to the watts of input of electrical power, while the spherical candles or "steinmetz" refer to the watts of output of light flux.

Unfortunately the "dimensions" of quantities, in the usual absolute system, which are often so useful, will not help us to distinguish between the various light units; on the contrary, they tend to confuse rather than clarify. This is due to the facts that angles have no dimensions in that system, and that the system does not distinguish between a surface perpendicular to a radiation, and the square of a distance in the direction of a radiation; both are L^2 in that system, although their physical meanings are radically different. Our present system of dimensions similarly fails in distinguishing between torque and energy, both of which are measured in pounds × feet and have the same "dimensions," yet torque is not energy at all; it must be multiplied by an angle to convert it into energy, and angles have no "dimensions."

It may be of some interest to know what the approximate numerical values would be of a new system of photometric units based on the "steinmetz" or 1-watt flux unit. To do this we must know the mechanical or electrical equivalent of light, or the light efficiency of an electric lamp, which unfortunately has never been determined with any degree of certainty. But for the sake of getting at least an idea of the approximate order of magnitude of these units, let us assume that the light efficiency of a 2-watt per spherical candle electric lamp is of the order of about 1 per cent, as has often been claimed; it is probably less, possibly much less. This means that if all of the electrical watts were converted into watts of light, the lamp would give 100 times as much light. It is assumed here that the new unit means 1 watt of *light* flux as such, and does not include any heat radiation. The color is here neglected, as it is in most of our photometric measurements.

In establishing such a system of units it is open to our choice whether we will adopt for the solid angle the steradian (subtending a unit area at unit distance) or the sphere, which is the maximum possible solid angle, and is equal to 4π (approximately 12½) steradians. The orthodox way would be to use the steradian, and this was used in the Geneva units. Either is mathematically correct, but there may be some advantages in using the sphere; if so, why not take advantage of it and adopt it before it is too late? We should select that one which involves this troublesome 4π factor in the least frequent calculations, as its complete suppression seems impossible. The following table has, therefore, been calculated for each system:

APPROXIMATE VALUES OF NEW UNITS BASED ON A 2-WATT PER SPHERICAL CANDLE LAMP HAVING AN EFFICIENCY OF 1 PER CENT.

New Units.	Unit solid angle or steradian.	Spherical unit.
Flux	1 watt	1 watt
Intensity	628 candle-power.	50 candle-power
Illumination (meter)	628 met. cand.	50 met. cand.
" "	58 ft. cand.	4.7 ft. cand.
" (foot)	628 ft. cand.	50 ft. cand.
" "	6770 met. cand.	538 met. cand.
Quantity of light	1 watt-hour.	1 watt-hour

In the first one there is 1 watt of power in the form of light flux radiated in a conical beam of one unit angle; in the second, this same amount of power is radiated uniformly in all directions from a center. The meter and foot have been adopted as the unit of length and surface in the illumination units because the centimeter would give enormously greater values, which never occur in practice.

It will be seen that the values are rather high as compared with those met with in practice, and a unit ought preferably to be smaller than the quantities to be measured so as not to involve fractions. They are especially large for the system based on the steradian. A fair illumination for reading is of the order of

[1] In calculating the cooling surface of electric conductors, we use the term "watts per square inch" for the rate of radiation of the heat. Illumination, as has just been shown, can be measured in "watts per square foot;" hence these two quantities are really of exactly the same nature, as they should be.

about 1 foot-candle (4 ft. from a 16-cp lamp); it is about the same on the average photometer screen. Probably the centi- or the milli-units would be conveniently small.

Some old determinations of light efficiencies[1] which the writer has reduced to modern units gave the equivalent of light flux and power to be about 5.3 spherical candle-power of flux for 1 watt of power, or 0.188 watt for one spherical candle; the former, however, is probably too small, perhaps far too small (or the latter too large). But on this basis the equivalent of 1 "steinmetz" (or 1 watt) of flux stated in candle-powers would be 5.3 candles if the sphere were used as the unit angle, or about 66 if the steradian is used. Some years ago the writer suggested that this figure might be determined by filtering the light rays of a source from the accompanying heat and other rays (if this is practicable), measuring the candle-power and then converting this cold light into heat by absorption on a black body and measuring the heat produced. This would probably be much more accurate than the older methods of measuring the difference between two quantities which are nearly alike and hard to measure accurately.

In the above calculations of the candle-power corresponding to the new unit of flux it should be understood that this would be the candle-power of a source (considered as a point) which would correspond to this new unit, according to our present system of light units; that is, to 1 watt of light radiating from a point. It does not mean that the flux unit itself necessarily involves any particular candle-power. If, for instance, lamps were constructed to be used as convenient concrete secondary standards and made to give the *equivalent* of the new unit of flux, they would have the candle-power calculated above. The usual photometric measurements made with this secondary lamp standard would then measure a source of light directly in terms of equivalents of this 1-watt unit. All such calculations involving the angle are, of course, independent of whether the metric or the English system of measures are involved.

The illumination units in the table were all calculated so as to correspond to the well-known law that the illumination varies inversely as the square of the distance from a point source. This law is so well known and so much used in all photometer work that it would be very undesirable to introduce the factor 4π into it. By defining the unit according to that law, this factor is eliminated from such calculations. The values are given for the foot-candle unit and for the meter-candle unit, as also for each in terms of the other.

But there is another way in which the unit of illumination may be defined, namely, on the basis that illumination = flux ÷ surface; in that case the unit would be one watt of flux (a steinmetz) per square meter. This is an unusual way of defining it, and is not so generally understood; there is, moreover, no common name for it, as it would seem irrational to give it in terms of foot candle when the candle is not involved in it. In the system based on the steradian it makes no difference, as the unit is then numerically the same whether defined in the one way or the other, because the conical beam at one meter has a cross section of one square meter and the illumination is one new meter candle-unit (628 meter candles). But in the system based on the sphere the two units would be different, because at one meter distance at which the illumination according to the usual law, would be one new meter-candle-unit (50 meter candles) the cross section of the flux is 4π square meters (the surface of the sphere), hence the second unit would be $1 \div 4\pi$ times as small; and if it were used, this factor would have to be introduced into all the most frequent photometric calculations, namely, those involving the law of the inverse square of the distance; this would surely be objected to by all photometrists. Calculations with the formula: illuminations = flux ÷ surface, are so rare in comparison that it would be much better to shift this factor into those instead, and leave the more frequent calculations as simple as they were. The table was therefore calculated on this basis, and for the illumination units in the spherical system it must be understood that the flux density is not one watt per square meter or foot, but $1 \div 4\pi$ or 0.07958 watt. For calculating the flux density (illumination) in terms of such units, from the flux and the cross section, the formula becomes

$$\text{illumination} = \frac{4\pi \text{ flux}}{\text{square meters or feet}}$$

One way out of this difficulty would be to use two different illumination units, each one with a different name, one based on the one definition and one on the other, each being used only in its own sense. The 4π factor would then fall out of each, and would enter only in transforming quantities from one to the other. This would be something like using gram weights at the apothecary's and pound weights at the grocery; it is all right if you never buy the same goods at either. But it seems to complicate the system, for the sake of simplifying some of the calculations.

This complication might point in favor of the steradian system in which it does not exist. But in that system the inevitable 4π factor enters into another and apparently a much more common calculation, namely, in calculating the total flux, which we now term the spherical candle-power. Numerically it would be the same as the mean candle-power, if stated in spherical candles; but the new unit of flux would be the watt (or steinmetz) and the very important quantity to the industries (as that is what we buy and sell), namely, the total flux radiating from an artificial source of light, would, of course, be then stated in watts and the spherical candle-power of a light in the new units would then have to always be multiplied by 4π to reduce it to watts, which would be quite troublesome. Our use of the quantity "watts per candle" shows how commonly we use this quantity.

The choice therefore seems to be in favor of the spherical unit, as the one involving the least calculations and as the one most easily understood. Everybody knows what a sphere and a spherical candle are, but few are familiar with the unit solid angle. Another advantage in its favor is that in our present system we already use the spherical candle as our unit of flux, when we speak of watts per candle, and the new one would therefore be no different in this respect.

[1] Mechanical Equivalent of Light. Hering. ELECTRICAL WORLD, April 20, 1901, page 631.

Note on the Primary Standard of Light.

BY C. W. WAIDNER AND G. K. BURGESS.

THE Congress of Gas Industry, which was held in Paris in 1900, provided for an International Photometric Commission. At the first meeting of this commission in Zurich, in June, 1903, it was proposed that photometric investigations should be undertaken with the object of establishing the ratios of the ordinary standards of Germany, England and France.

At the second meeting of this commission,[1] held at Zurich in July, 1907, the following relations between the several flame standards used in these countries were agreed upon, as a result of the work carried out in the various national standardizing laboratories:

Carcel = 10.7$_0$ Hefner.
Vernon-Harcourt = 10.9$_8$ Hefner.
Vernon-Harcourt = 1.02$_0$ Carcel.

With reference to the Violle standard, a resolution, of which the following is a translation, was unanimously adopted:

"In view of the new resources which the work of Moissan has shown to be available in the use of the electric furnace, especially in the fusion and distillation of the refractory metals, and on account of the photometric interest of the melting point of platinum, the International Photometric Commission desires to see further experimental study of the fixity of this temperature, and suggests to its executive officers that they enter into communication with the various national laboratories with a view to solving this problem."

This opens up anew the question of the reproducibility of

[1] *M. F. Laporte*, La Commission Internationale de Photométrie, Zurich, July, 1907. *Bull*, Soc. Int. des Electriciens 7 (2), p. 487; 1907.—ELECTRICAL WORLD, 50, pp. 575, 931; 1907. *Electrical Review*, 51, p. 756; 1907.

the Violle standard. Since co-operative work is contemplated, and the representatives of the Physikalisch-Technische Reichsanstalt and of the National Physical Laboratory at this conference have signified their intention of carrying out work along these lines, it may be worth while to consider at the same time a modification of the Violle standard, which may lead to higher accuracy in reproducibility, which is independent of the selective emission of the surface of platinum and of impurities on this surface, and which also has certain theoretical advantages.

As none of the ratios of the various practical standards used in photometry to-day to the Violle standard has ever been determined satisfactorily, any change in the definition of the primary standard of light will introduce no confusion. The Violle unit has never been consistently reproduced by any observer other than Violle, and the effect of varying atmospheric conditions on the flame standards was not known accurately at the time of Violle's comparisons of the platinum unit with the carcel[1] and hefner[2] lamps.

The primary standards that have been suggested for photometric purposes may be classified under three heads: (1) Flames; (2) incandescent surfaces; (3) vacuum tubes.

FLAME STANDARDS.

Among the flame standards that have been used to a considerable extent are the carcel lamp, the British and German standard candles, the Methven screen, the Hefner-Alteneck amylacetate lamp, the Vernon-Harcourt pentane lamps, and to a much lesser extent the oxide mantles and the acetylene flame.

Flame standards are subject to numerous sources of variation, such as those arising from lack of constancy in the chemical composition of the combustible, in the height and transparency of the flame, in atmospheric conditions and draughts, in mechanical details of construction of the lamp, and in the nature, form and position of the wick. The effect of many of these variations on the intensity of the light has been carefully investigated for several of the flame standards, so that if products of assured purity are burned in a lamp of definite construction, it is possible to reduce the observed intensities of these flames to standard conditions of flame-height, barometric pressure and atmospheric content of water vapor and carbon dioxide. The magnitude of some of these corrections may be very considerable; thus, for the Hefner and Harcourt standards the variation of intensity due to seasonal changes in atmospheric humidity may attain nearly 10 per cent, and for the Hefner the variation of intensity is about 3 per cent per mm change in height of the flame from the normal of 40 mm.

The result of numerous investigations on the flame standards used in England, France and Germany, namely, the Harcourt, Carcel and Hefner lamps, respectively, show that the accuracy of reproducibility of the standard light unit defined by these lamps, by different observers, is of the order of 2 per cent, certainly not as high as 1 per cent. Thus, in addition to the numerous corrections which it is necessary to apply in order to reduce to standard conditions, and the many possible causes of variation, there are conditions which may lead to constant differences in the results of different observers. For instance, in the estimation of flame height, two observers may differ consistently by 0.5 mm or more, owing to the effect of the semiluminous region above the flame. The reddish color and low intensity of some of these flame standards, notably of the Hefner, are also unsatisfactory.

For the reasons briefly referred to above, there seems to be little hope of finding a satisfactory primary standard of light by means of flame standards.

VACUUM-TUBE STANDARDS.

The most recent suggestions for a primary standard of light are based on the emission of light by an electric discharge through a vacuum tube. Nutting[4] has investigated the constancy and reproducibility of the light emitted by the discharge through helium under definite conditions in a capillary tube of specified dimensions. His preliminary experiments indicate a possible reproducibility greater than that of the flame standards. The principal objections to the helium lamp as a standard would appear to be its pinkish color and low intensity.

Steinmetz[4] has suggested as a unit of light, that given by one watt of power radiated at three selected wave-lengths, whose intensities are in such proportions as to give white or yellowish-white light. For a realization of this unit he would select a blue, a green and a red line from the spectrum of the mercury arc, a separate mercury lamp being required for each spectral line. The practical establishment of such a standard has not yet been attempted, but would evidently be attended by very great experimental difficulties, as it would require the bolometric measurement and adjustment of the minute rates of energy associated with single spectral lines from three separate sources.

A common disadvantage of all vacuum-tube light standards lies in the use of a discontinuous spectrum, which renders them unsuitable for spectrophotometric standards of reference.

INCANDESCENT-SURFACE STANDARDS.

The essential requirements of a standard of this kind are: a sufficiently high temperature to give a spectral distribution suitable for photometric comparisons, a sufficient constancy and reproducibility of this temperature, and a constant emissive power of the surface used. The great difficulties lie in maintaining a surface at a constant emissive power, and in fixing the temperature with the required degree of accuracy, since a variation of 1 per cent in temperature corresponds to a variation of from 12 to 18 per cent in the intensity of the light emitted, depending on the temperature.

The Violle Standard.—At the International Congress, held at Paris in 1881, Violle proposed his platinum unit, which was adopted by the conference of 1884, and was defined as follows:

"The unit of each simple light is the quantity[5] of light of the same kind emitted in a normal direction by 1 sq. cm of surface of melted platinum, at the temperature of solidification."

"The practical unit of white light is the quantity of light emitted normally by the same source."

The adoption of this unit has been confirmed by succeeding electrical congresses, although it is to be noted that in no country are photometric measurements generally expressed in terms of this unit.

Violle, in four independent series of comparisons of the Carcel lamp with his standard, made under widely varying conditions, obtained results agreeing to well within 1 per cent. These experiments gave: 1 Carcel $= \frac{1}{2.08}$ platinum units.

An attempt to reproduce the Violle unit was made by Lummer[6] at the Physikalisch-Technische Reichsanstalt in 1891, using an oxy-coal-gas blowpipe to fuse the platinum, and subsequently in 1894 by a method[7] in which the platinum was fused by an electric current. Lummer found 1 Violle unit = 26 Hefners, while Violle[8] obtained 19.5.[9]

Somewhat later Petavel[10] made an extensive series of experiments on the reproducibility of the Violle unit, using the oxy-hydrogen, oxy-coal-gas and electrical methods of fusion, and came to the conclusion that the order of reproducibility was within 1 per cent, if proper precautions were taken to avoid contamination by silicates from the crucibles and by hydrocarbons from the heating flames.

Substitutes for the Violle Standard.—Many experimenters have endeavored to produce a simple substitute for the Violle

[1] J. Violle, Sur létalon absolu de lumière. *Ann. Chem. et Phys.* (6), 3, pp. 373-407; 1884.
[2] Int. Congress of Photography, 1899 (Paris). *Reports and Documents.* p. 59.
[4] P. G. Nutting, Luminous Properties of Conducting Helium, Electrical World, 51, p. 390; 1908. *Bulletin* Bureau of Standards 4, p. 511; 1908.
[4] C. P. Steinmetz, Primary Standard of Light, *Proc.* Am. Inst. of Elect. Eng., 27, p. 297; 1908.
[5] "Quantity" has been interpreted to mean "intensity" in this definition.
[6] *Zeit. fur Instrumentenkunde,* 11, p. 160; 1891.
[7] *Zeit. fur Instrumentenkunde,* 14, p. 266; 1894.
[8] Congres International de Photographie, Paris, 1889; *Reports et Documents,* p. 56.
[9] This determination is inconsistent with 1 Violle = 2.08 Carcels, for taking the ratio of the Carcel to the Hefner, as given in Table I, we should find 1 Voille = 22.4 Hefners from Violle's earlier measurements on the Carcel. How much of this discrepancy should be attributed to the flames is uncertain.
[10] J. E. Petavel, An Experimental Research on Some Standards of Light, *Proc.* Roy. Soc., 45, p. 469-503; 1899.

standard. Some of these observers seem to have lost sight of the fact that cheapness and portability are not essential requirements of a primary standard.

Siemens[1] proposed as the photometric unit the intensity of the light emitted by 1 sq. mm of platinum ribbon at its melting point. Some experiments on this proposed unit were made by Lummer,[2] but the results were not regarded as very promising.

A modification of this standard, in which platinum wires were substituted for the ribbon, was investigated by Cross,[3] who regarded the proposed standard as worthy of further investigation.

Lummer and Kurlbaum[4] proposed as the unit, the intensity of the light emitted by a platinum ribbon, enclosed in a water-cooled box, at such a temperature that the intensity of total radiation after transmission through a 2-cm water cell with plane parallel quartz walls 1 mm thick, was 0.1 the intensity of the total radiation. They have given the reproducibility of this unit as about 1 per cent. On account of the selective absorption of the platinum black used on the bolometer strips, it was found important to define carefully also the conditions under which this absorbing layer was deposited.

Petavel has tried to realize a somewhat similar standard, in which the temperature of the platinum ribbon was such that the radiation transmitted by a water cell, which becomes more transparent with increasing temperature, was balanced against the radiation transmitted by a thin layer of black fluorite, which becomes less transparent as the temperature is increased.

None of these proposed substitutes for the Violle standard have as yet led to any definite results; nor do they seem to give promise of greater accuracy or reproducibility than the original Violle standard. As a further disadvantage, those standards which are based on the melting of a platinum ribbon or wire require instantaneous photometric comparisons.

Radiation from Carbon.—Swinburne and Thompson[5] were led by Abney's work[6] to suggest the intensity of the radiation from a definite area of the positive crater of the carbon arc as a primary standard of light; but the experimental work of Blondel,[7] presented to the International Electrical Congress at Chicago in 1893, showed that at best the arc could serve as a secondary standard only in arc photometry. His results varied through a range of 8 per cent. Measurements of the temperature of the arc by Petavel[8] and by the authors[9] have shown similar variations in the photometric intensity of the positive crater with current and with the quality of the carbons.

The radiation from the carbon filaments of incandescent lamps have frequently been suggested as primary standards, but in addition to the almost insurmountable difficulty of fixing the temperature of the filament with sufficient accuracy, the emissivity of carbon is a variable dependent on the total time of using and the mode of preparation of the filament. The same difficulties would be encountered in the use of the metal-filament lamps for such a purpose. Incandescent lamps are, however, admirably adapted for use as secondary and working standards.

It is doubtful, if, at the present time, a primary standard can be constructed so as to be reproducible to the order of accuracy with which incandescent lamps can be inter-compared. This does not lessen the desirability, however, of defining the primary standard as accurately as may be. The situation is similar to that of electrical resistance. Wire resistors can be inter-compared as to resistance with greater accuracy than the standard ohm can be reproduced in accordance with its definition; yet the proposition is not made to define the standard ohm in terms of wire coils, because the specifications cannot be drawn and fulfilled so as to reproduce the ohm in the form of a wire coil with sufficient accuracy. At the present time, however, there is no doubt that any light unit, that might be agreed upon, could be reproduced and maintained with the highest accuracy by means of a number of standard incandescent lamps used only for short periods at occasional intervals. The chief function of a primary standard would be then to control slow changes (in the course of many years) that might occur in the unit so maintained.

[1] W. Siemens, *Electrotech, Zeit.*, 5, p. 244; 1884.
[2] *Zeit. f. Instrumentenkunde*, 11, p. 160; 1891.
[3] C. R. Cross, Am. Acad. Sci., June 16, 1886; *London Electrician*, 17, p. 514; 1886.
[4] Lummer and Kurlbaum, Bolometrische Untersuchungen für eine Lichteinheit, *Sitzungsber* Berlin Akad., 1, pp. 229-238; 1894.
[5] S. P. Thompson, On the Swinburne-Thompson Unit of Light, *Proc.* Int. Elec. Cong., Chicago, pp. 267-269; 1893.
[6] Abney, *Proc.* Roy. Soc., 27, p. 157; 1878; *Phil. Trans.*, 172, p. 387; 1881.
[7] A. Blondel, On the Continuous Current Arc and Its Employment as a Photometric Standard, *Proc.* Int. Elec. Cong., Chicago, pp. 315-334; 1903. Au Sujet de l'Unité de Lumière, *La Lumière Elec.*, 50, p. 222; 1893.
[8] J. E. Petavel, *Proc.* Roy. Soc., 65, pp. 469-503; 1899.
[9] Waidner and Burgess, On the Temperature of the Arc. *Bulletin* Bureau of Standards, 1, pp. 109-124; 1904.

SUGGESTIONS FOR A PRIMARY LIGHT STANDARD.

The essential characteristic of a primary standard of light is that it reproduces with sufficient accuracy the unit it is intended to define. Cheapness, simplicity and portability, while desirable, are by no means essential. It should be of such magnitude and intrinsic brightness that it can be compared readily with a suitable secondary standard; and for convenience of spectrophotometric measurements, it is desirable that it give a continuous spectrum.

The light emitted by any incandescent body depends on its temperature and on its surface conditions. An ideal light standard would be one in which the temperature of the incandescent body, at a suitably high temperature, is automatically fixed with sufficient accuracy by some natural process; and in which the emissive power is independent of the physical and chemical properties of the body.

The Violle standard represented an attempt to realize the first of these conditions, namely, a constant and reproducible temperature, but it does not realize the second condition, as the intensity of the radiation is dependent on the emissive power of a platinum surface. The surface radiation from platinum may be variable, being influenced to a marked degree by impurities in the platinum and especially by even the slightest contamination of the surface. Again, the spectral distribution of the light intensity is changed when the surface suffers contamination, which is an objection to the use of the platinum unit as a spectrophotometric standard. Furthermore, the presence of the adjacent incandescent walls of the crucible and furnace containing the platinum, as well as of surrounding screens and diaphragms which reflect light, will influence the apparent brightness of the platinum surface.

It may be worth while, at this point, to recall the important characteristics of the black-body and of its radiation. A black-body is one which completely absorbs all radiation incident upon it, and which, therefore, neither reflects nor transmits any radiation. No material substance is "black" in this sense, although carbon and certain black oxides are nearly so, while substances like gold and platinum are far from being black. Kirchoff showed that the radiation from a black-body would depend only on its temperature and not at all on the physical or chemical properties of the material of which it was made; and, further, that the radiation within an enclosure whose walls are at a uniform temperature is black-body radiation. The practical experimental realization of black-body radiation was first attained by Lummer and Wien, who utilized the radiation emerging from a small opening in the wall of a uniformly heated enclosure.

A smooth surface of pure platinum at its melting point, which is somewhere in the neighborhood of 1750 to 1780 deg. C., radiates only as much red ($\lambda = 0.67\mu$), green ($\lambda = 0.55\mu$) and blue ($\lambda = 0.47\mu$) light as a black-body at 1539 deg., 1585 deg. and 1627 deg. C., respectively.[10] Every contamination or roughness of the surface increases its emissivity and makes its radiation approach more nearly to black-body radiation by different amounts for each color; and enclosing the platinum within a reflecting envelope increases the apparent emissivity very greatly.

It is evident from the above considerations that it is highly desirable to eliminate from the standard of light the platinum surface with its variable emissivity and to substitute for this surface the black-body whose radiation depends only on its temperature. This change would be desirable even if the platinum surface could be maintained at an absolutely constant

[10] Waidner and Burgess, Radiation from and Melting Points of Palladium and Platinum, *Bulletin* Bureau of Standards, 3, pp. 163-208; 1907.

emissivity, on account of the known simplicity of the radiation laws of the black-body, whose constants are independent of the materials of which it is constructed. For the same reason it would be advantageous in spectrophotometric work and in problems in selective radiation to refer all photometric measurements to the radiation from the black-body.

All of the advantages of the Violle standard as to constancy of temperature would be retained by adopting as the unit of intensity the radiation from a definite area of a black-body at the temperature of solidification of platinum, and at the same time the difficulties arising from the surface radiation of platinum would be avoided.

The criticism may be made at this point that ideal black-body conditions cannot be realized, as it is necessary to have an opening in the walls to allow the radiation to pass out and that it is not possible to heat the walls of the experimental black-body with absolute uniformity. The departure from ideal black-body radiation due to these causes is, however, quite small, equivalent to only a few degrees in temperature and it could be kept always the same by carefully specifying the form and dimensions of the black-body, its condition of immersion in the molten metal and so forth.

The suggested use of a black-body at a definite temperature is, of course, not new.[1] The point to which the authors would direct attention is the use of the Violle method of fixing this temperature by means of the freezing point of platinum. If this temperature is not sufficiently fixed and reproducible, then the Violle standard must also fail, while if it is fixed, the use of the black-body eliminates one of the most troublesome features of the Violle standard, namely, the variable emissivity, and gives additional theoretical advantages.

It may be possible to realize this combination of the black-body and platinum standards in several ways; for example, by immersing a black-body of specified dimensions and material, such as a properly diaphragmed cylinder of fused alumina or magnesia, in a crucible of molten pure platinum in some form of electric furnace, such as an induction or resistance furnace, whose temperature may be controlled nicely to give very slow solidification of the platinum. If, then, the temperature of the platinum remains constant during solidification, the intensity of the light emitted by the immersed black-body will also remain constant.

The above method would, of course, require the use of a considerable mass of platinum. This may be avoided by placing the black-body in a bath of some molten metal, as iron or nickel, with a small mass of platinum inside it. In this case, the radiation will come in part from the platinum surface, but since the platinum is within the black-body, this radiation is nearly independent of the properties of the surface of the metal. The platinum surface may be completely eliminated by covering it with a suitable powder. In both of these methods the time during which the temperature remains constant, or while solidification is taking place, would be recognized from the photometric measurements, as in the original Violle standard.

The experiments should be carried out on platinum of the highest attainable purity and the effects of slight impurities on the freezing point investigated to decide whether the present methods of refining platinum will furnish a product having a sufficiently constant freezing point, since 1 deg. C. variation in the freezing point will cause a variation of over 0.5 per cent in the intensity of the light emitted.

The authors have made a few preliminary experiments on the constancy of the freezing points of several metals using specially designed black bodies of magnesia immersed in pure cobalt. It is planned to extend this work along the lines indicated above.

A less promising method, but one requiring a very small quantity of platinum, would be a combination of the black-body with the Siemens method of fusing a platinum strip. This could be realized by placing the radiating platinum strip in a hemispherical reflector and observing the middle of the strip through a small opening in the hemisphere, thus making the radiation from the platinum a close approximation to black-body radiation.

[1] Lummer and Pringsheim, *Physik. Zeit.;* 3, p. 97; 1901-2. Nernst, ibid., 7, p. 380; 1906.

CONCLUSION.

Since further work on the Violle standard is contemplated, the authors would suggest that simultaneous experiments be carried out on the black-body platinum standard, as very little additional equipment is required. There is no *a priori* reason why this standard should not be at least as reproducible as that of Violle and it possesses additional theoretical advantages. *The unit of light,* based on this standard, might be defined as the *intensity of the light (white or monochromatic) emitted by 1 sq. cm of a black-body at the temperature of solidification of platinum.* The conditions under which the standard should be constructed for reproducing this unit, such as the dimensions and material of which the black body is constructed, its depth of immersion and other factors, must be carefully specified.

From the measurements of Nernst[2] on the intensity of radiation from a black-body, it appears that the intensity of this unit would be about 88 hefners. The decimal subdivisions would, therefore, be convenient for comparison with the ordinary light standards.

The Dynamic Brake in Printing-Press Drive.

By S. H. Sharpsteen.

Cleanliness, flexibility of speed control and neat appearance have caused the electrical drive for printing presses to become popular. The removal of belting and shafting has permitted the pressroom ceiling and walls to be kept clean and white, and saved artificial illumination and waste of paper and printed product by dispensing with oil and dirt.

Dispensing with the shafting and belting should make a large saving in energy required to operate the presses. The saving, however, has not been so marked as might be expected, one reason being the waste of energy in field coils that are usually in circuit throughout the whole day and in the coils used for various purposes in connection with the controlling devices.

In many cases pressrooms with individual electric motor-drive have excessive maintenance accounts. This is due in part to the printer's lack of knowledge of electrical apparatus.

Many large printing establishments now contain a variety of apparatus for which it is difficult to get repair parts. Different ideas have been adopted from time to time when installations were made, the result being a promiscuous lot of electrical devices that are expensive to keep running. Formerly flat-bed presses were built for belt drive. The designing engineer in planning brakes knew the strength of the machine parts that were gear-driven and arranged his braking devices accordingly. When printing-press-drive was changed from shafting to electric motor, the press builder allowed the electrical engineer to assume the responsibility for the brake. The result was not satisfactory because the electrical engineer did not understand the importance of having this work carefully done, and the manufacturers of electric motors erred in allowing the motor which was designed for driving only to be used for a brake to bring to rest the heavy parts of the flat-bed press.

The change in printing-press drive went from one extreme to the other, the shafting being abandoned in favor of an electric motor, which was placed directly on the driving shaft of the press. This new drive was expensive. The printer wanted to increase the output of the press to compensate for additional investment, hence the large slow-speed motor on the main shaft of the press was caused to hurry the press ahead at start; when the feeder wished to stop the press he did so in a very sudden manner in many cases. At starting the press the slack between the teeth of the gears and pinions was sufficient to produce only slight blows before the last part of the press was moving, but when the motor held these teeth close together in

[2] *Zeit. f. Elektrochemic,* 9, p. 622, 1903.

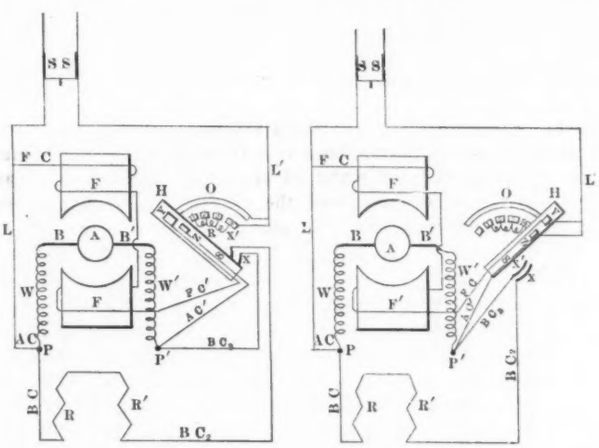
driving the press ahead and then was suddenly stopped the maximum space between the gear and pinion teeth made a reverse blow that loosened keys and feathers in the press and in some cases broke the gears and other parts of the press.

The reversing of the bed was not a difficult problem with belt drive, because at the end of the bed-travel the belt from the shafting would slip and let the bed reverse at its leisure, but when the motor was geared to or placed on the shaft of the press a decrease in the speed of the motor meant an inrush of current and an increase in torque that would send the bed back with a rush. This action in some cases would cause the current in the armature to vary from zero to 50 per cent overload.

A heavy flywheel placed on the driving shaft of the press protected the motor, but produced a more severe blow on the mechanism of the press than was caused by the momentum of the armature with its extra torque from the inrush of current.

Troubles of the above nature were eliminated somewhat by using a short belt to connect the motor to the press. As with the original belt-drive from the shafting, the belt acted like a cushion between the driver and the driven pulleys.

A dynamic brake used in the printing business is illustrated in Figs. 1 and 2. Assume that Fig. 1 shows an electric motor equipment installed to operate a flat-bed printing press. On closing the service switch *S S* the press wiring *L* and *L'*, which are connected with the source of electrical supply, are subjected to a difference of potential of 220 volts. This e.m.f. produces a current through the field circuit *F C* of the motor. This field circuit extends from wire *L* around field magnets *F* and *F'*



FIGS. 1 AND 2.—DIAGRAMS OF CONNECTIONS.

from the motor to the controller on wire *F C'*, up the controller handle *H* to the brush *Y*, and by means of the strip of copper *O* on the face of the controller reaches the other wire or leg of the circuit *L'*. The armature circuit for press driving is made up of wire *A C*, binding post *P*, motor brush cable *W*, brush *B*, armature *A*, brush *B'*, brush cable *W'*, binding post *P'*, wire from motor to controller *A C'*, to brush *Z* in the controller arm where this circuit is now open as the press is assumed to be at rest. When brush *Z* stands on point 1 the circuit is completed through the starting rheostat *R* to the other leg of the circuit *L'*.

Having supplied a strong magnetic field by closing the main switch *S S*, pushing the lever *H* to the left until the brush *Z* stands on point 1 of the controller dial, the armature *A* starts the press. When the handle *H* is in the position indicated in Fig. 2 the motor should be up to maximum speed driving the press for production. This is the work for which the motor was designed and for which it will do well with very little attention.

From binding post *P* extends a wire *B C* which connects with resistor *R* and *R'*. These resistors are connected to *X* by means of wire *B C₂*. Binding post *P'* is joined to *X* by *B C₂*. This connection forms the dynamic brake circuit; when the motor is running as in Fig. 2 this circuit is open at *X* and *X'* so that no current can pass.

Assume now that the press under consideration is doing jobwork and must be stopped and started often; in order to keep the production up the press should be stopped quickly. When something goes wrong the pressman or automatic feeder causes the controller handle *H* to come back quickly to the off position as represented in Fig. 1. In this position the handle *H* closes a circuit through the armature and resistors *R* and *R'* by placing a piece of metal from *X* to *X'*. Electricity ceases to drive the motor as the driving circuit is open at *Z*, but the momentum of the heavy moving parts of the press compels the armature to revolve, and in an instant the machine is changed from a motor with a normal amount of current passing through it to a dynamo with an excessive amount of current which is turned into heat by the resistors *R* and *R'*.

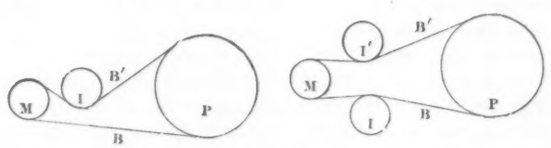
There are cases where dynamic brake is allowable when motor drive is used, but with the hurry methods of a modern flat-bed plant a dynamic brake is disadvantageous, as it causes excessive depreciation.

All resistors are liable to burn out or short circuit, and no man in charge of motors can detect this defect readily, as these resistors are now installed, the result being that presses and motors are abused when these troubles arise.

Many electric motor-driven flat-bed presses run through the night with no electrician on duty. If the resistor in the brake circuit fails to operate properly and the equipment performs in an unusual manner, the pressman thinks merely of the output, and as long as the press will operate at all, it will be kept turning. Finally, some other part may fail and compel a shutdown. In the morning probably there will be found a belt ruined, a gear broken, a motor shaft sprung or a commutator or armature winding in such shape that a general overhauling is necessary.

The printing business demands that commutator and brush troubles, as well as general motor repairs, be kept down to a minimum. This result can be accomplished only by removing the dynamic brake from the printing press motor equipment and dispensing with the excessive strain on the motor shaft and bearings.

The dynamic brake causes electric motor drive with a short



FIGS. 3 AND 4.—ARRANGEMENTS OF IDLER PULLEYS.

belt to be a bad engineering problem. In Fig. 3 consider that *P* is the main pulley of a flat-bed printing press and that *M* is the driving pulley of a motor installed to operate the press. The conditions are such that a short belt is advisable; however, a belt stretches when it commences to pull and when the slack side *B'* is short there is not weight enough to pull it down and cause it to grip the motor pulley *M*. To remedy this trouble an idler pulley *Z* may be placed on the slack side to compensate for the lack of weight in the belt. Since the idler pulley has no heavy duty to perform it can be supported on a light arm and shaft. No oil or grease is necessary if a proper type of bearing is used. This arrangement is ideal, as the belt can be thin, flexible and so loose that the idler pulley may be lifted and the belt taken off easily.

If a dynamic brake is used the conditions are very different. Just as soon as the brake is applied the pull is changed to the idler side of the belt *B'*, the light idler pulley is thrown up and the belt slips. In installations where idlers are not provided, use is made of heavy belts that will waste energy for years in being bent around pulleys and driving with excessive friction at the bearings when the weather conditions cause the belt to shorten.

In a certain installation in Greater New York there are two

idler pulleys, as shown in Fig. 4, arranged with arms so that the idler pulleys *I* and *I'* can move up or down as the case may demand.

Where the single idler is used with a dynamic brake the whole idler-gear must be heavy and cumbersome to withstand the braking strain and a heavy spring is necessary to hold the idler pulley in position. Moreover, belt renewals and repairs are excessive.

An electric brake placed on the shaft of the press by the press builder and arranged to be operated from the controller will dispense with all dynamic brake troubles. Excellent electrical brakes have been developed by elevator manufacturers.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Boston Edison Company's Directory.

The Edison Electric Illuminating Company, of Boston, recently placed in its office building at 39 Boylston Street a directory which not only gives the names and locations of the different departments and where the various employees are to be found, but also provides for the transaction of business in foreign languages. The names of representatives of the company who are able to speak French, German, Italian, Greek and Swedish are given. The rates of the company are printed in Yiddish as well as English, the latter, however, being in folders. When any person calls who does not speak English sufficiently to enable the elevator men to understand him, the visitor has only to be taken to the directory board, where he can point out the language indicated by the words that he can read. Electricity is very extensively used by the foreign population of Boston.

Experience of Ohio Central Stations with Tungsten Lamps.

At the Ohio Electric Light Convention at Put-in-Bay, Ohio, in August, Mr. D. L. Gaskill, secretary of the Ohio Electric Light Association, presented an extensive set of reports from Ohio central stations, on experiences with tungsten lamps prepared at the request of the president of the Ohio Electric Light Association. The inquiry as sent out called for the experience of the stations on the sizes used, breakage in shipment, trouble with discoloration, life, economy, value in meeting competition, advantages of frosted over clear tip bulbs, type of shades to be used, manner of disposing of them to the consumer and other information of interest to central station men. Reports are designated by numbers instead of by names of companies.

Station No. 1, in a city of 125,000 population, reports the 100-watt lamp extremely satisfactory, especially for competing with gas and gasoline lamps. The only difficulty has been the blackening of some of the lamps in from 50 hours to 150 hours. This defect, however, has been corrected by the factory and no future trouble is anticipated. The frosted tip has an advantage over the clear tip in some cases and about an equal number of each is used. The average breakage from all sources, including handling, premature burnouts, etc., amounts to 8 per cent of the 900 lamps handled. Lamps are not rented, but are sold outright. Experience so far has been all with the 100-watt size.

Station No. 2, in a city of 12,000 population, finds the lamps good to compete with gas or gasoline lamps. Some of the earlier lamps are blackened a little. The life is something extraordinary. In four months' time none has burned out. A few have broken from rough handling. The company finds it the best policy to put up the lamp and see that it is installed properly. The company has had fifty 4-amp series lamps on a magnetite arc circuit for four months without a single breakage.

Station No. 3, in a town of 4000 inhabitants, has been using 60-watt and 40-watt lamps since Jan. 1, and is now using a few 100-watt lamps. It has had six broken lamps out of five cases. Three burned out. These lamps are installed with pendant switches. They have already replaced three gasoline lighting installations. Consumers are charged the difference between the price of a tungsten and a carbon filament lamp.

Station No. 4, in a city of 40,000 inhabitants, has installed about 500 lamps of the 40-watt, 60-watt and 100-watt sizes. It has not had time to arrive at definite conclusions about life. During the month of May it put out 75 100-watt, 30 40-watt and 34 60-watt lamps. It had to replace 11 of the 100-watt lamps inside of 10 days, 4 of the 40-watt and 3 of the 60-watt. Out of a shipment of 200 lamps, 13 were broken when received. The tungsten lamp has been a great aid in securing business that could not be reached before.

Station No. 5, in a city of 150,000 inhabitants, engages local dealers to sell the lamps. It wishes to encourage the use of tungsten lamps, but has not determined how it will supply them to its customers. For the present it does not furnish the lamp direct. The opinion is that this lamp will eventually put an end to free renewals, the lamps being purchased from dealers.

Station No. 6, located in a city of 8000 inhabitants, allows the supply houses to handle tungsten lamps, as it found that when the company furnished them, customers expected a rebate on short-lived lamps. At the same time customers seemed to be willing to purchase from supply houses without any guarantee.

Report No. 8, from a wiring contracting firm, shows that the tungsten lamp makes new contracting work easier to procure. It enables the business man in moderate circumstances to display his goods in the right way at a cost not exceeding that for his former method of lighting, and finds that breakage in shipment has been reduced to a point equal to the carbon lamp.

Station No. 9, in a city of 8000 inhabitants, has installed three standard packages of tungsten lamps. It has found it a very valuable help in getting new business. The principal trouble has been with the life of the lamp. The experience has been such as to warrant reducing about half the claim of the manufacturers as to the number of hours of normal life. The company gives records of five installations. These installations were placed on a rental basis. The company gives the consumer the privilege of buying the lamps outright at a price 10 per cent less than listed, or paying a monthly rental of 25 cents per month for each 60-watt or 100-watt lamp and 20 cents per month for each 40-watt lamp installed. Of the five installations on rental, the records show that the company has lost money even after allowing for the cost of free renewals if carbon lamps of equal candle-power were used. Nevertheless, as the company makes free lamp renewals, it feels justified in continuing the experiment of renting the lamps. In estimating the cost of free renewals 0.5 cent per kw-hour was taken as a basis.

Station No. 10, in a town of 3000 inhabitants, has 100 60-watt lamps in use, 150 40-watt and 20 100-watt. Six or eight lamps have burned out after a few hours' use. It has no competition other than from gasoline lamps, which the tungsten lamp successfully meets.

Station No. 11 has had tungsten lamps in service since March 1. July 24 it had a total of 500 in use, with an average life of 1000 hours. It has 60-watt lamps on test that have run over 2000 hours. The only trouble experienced was with the 100-watt size. The first shipment in March did not have perfect vacuum. It has replaced gas lamps with tungsten lamps where Gem lamps could not. It is pushing tungsten lamps because it furnishes free renewals and free trimming on carbon incandescent and arc lamps.

Station No. 12 reports that on a lot of 100 lamps of 100 watts, 50 lamps of 60 watts and 50 lamps of 40 watts, the loss by breakage in shipment was one 100-watt and one 60-watt lamp. It has placed tungsten lamps in several stores where the income has been decreased about 40 per cent. In others it has increased 25 per cent because of the cutting out of natural gas. Flat-rate customers do not seem to be any more careful because of the high price of the lamp, even though the customers must purchase the renewals, but they probably will be after the lamps have burned long enough so that renewals must be purchased.

Gas Notes from England.

The accompanying illustrations are reproduced from the columns of our vivacious London contemporary, *The Electrical Times*. One shows the use made in Bournemouth of abandoned gaslight posts. The other illustrates a type of a new gas-

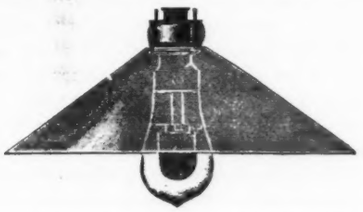


FIG. 1.—IMITATION ELECTRIC INCANDESCENT LAMP.

mantle lamp being placed on the market and called the "Electrin." On this latter our contemporary comments as follows:

"The fable of the ass in the lion's skin has no moral for the gas people. They continue to dress up their gas mantle so that

FIG. 2.—IMITATION ELECTRIC ARC LAMP.

it looks like electric light—at a distance—but the long ears persist in giving the show away, and there is no mistaking hee-haw for the roar of the nobler animal. The latest triumph of gas is the 'Electrin' burner, which carries imitation even into the name. When people started making imitation butter they called it butterine, but Parliament passed an act compelling them to call it oleo-something. To take a pride in making an imitation that looks 'just as good' as the real thing is a confession that the real thing is superior; and the trade that persistently copies its rival is degenerate, even if it be innocent of intent to deceive. The perverted ingenuity which produces half-crowns just like those which come from the Mint is generally associated in the mind with base metal."

Transformer Cooling.

The cooling of oil for transformers at some central point, instead of piping water to each transformer and providing the transformer with a water jacket, is a plan which when introduced met with much favor. Experience has shown, however, that to operate it safely each transformer should have its independent oil circulating and cooling system, so that the oil from the various transformers cannot mix. Assuming a bank of transformers to be supplied from an oil-cooling system connected to all, the burning out of one transformer will shortly ruin the oil for the whole bank. In fact, in one case recently it was found that even though the oil circulation of the defective transformer was shut off within one minute from the time the trouble began, the insulating value of the oil for the entire system was seriously lowered. To provide for instant closing of the oil valves in case of trouble introduces additional complications which nullifies the supposed simplification brought about by piping oil rather than water.

Gas Engines in Central-Station Work.

At the Ohio Electric Light Association convention, held at Put-in-Bay, Ohio, in August, Mr. William M. Adams, of the Citizens' Gas & Electric Company, of Elyria, Ohio, read a paper on "The Gas Engine in Central-Station Work," which was very favorable to the gas engine. He first compares the efficiencies of gas and steam engines for a typical 300-hp plant. He assumed that the steam plant was equipped with horizontal tubular boilers and automatic high-speed engines. The coal was assumed to contain 12,000 b.t.u. per pound. One pound of coal burned under the boiler will evaporate 5 lb. of water from and at 212 deg. Fahr. The engine will consume 30 lb. of steam per hp-hour, so that 6 lb. of coal would be required for a hp-hour, or 72,000 heat units per hp-hour. As one heat unit is equivalent to 778 foot-pounds of energy, and 1 hp is equivalent to 33,000 foot-pounds per minute, only 3.5 per cent of the energy of the coal is delivered in useful work. A gas-engine plant is found to require 9.75 cu. ft. of gas per hp-hour operating on gas containing 960 b.t.u. per cubic foot. Therefore, 9360 heat units of energy are delivered to the engine in the form of natural gas for each hp-hour obtained. This is 27 per cent of the energy in the fuel.

He claims that the gas engine to-day is more reliable than the steam plant, and that less attention is required to keep a gas-engine plant in good condition than is required for a steam plant of equal output. The chance of failure of the gas plant is less than for the steam plant. With the gas-engine plant the steam-boiler trouble is entirely eliminated. As far as the engine itself is concerned, it has its delicate points, such as the igniter. The gas engineer that does not frequently examine the ignition system and keep the magnets and battery in order would also allow a steam plant to get out of order. In summing up, there seems to be no good reason why the gas engine should not appeal to electric-light companies as an economical, reliable and efficient prime mover. To the prospective purchaser of additional units the installation of gas engines where natural gas is available should be seriously considered by progressive managers on account of the very low cost, as well as the reliability. Where natural gas is not available, the question of producer gas in connection with steam engines should be considered before a steam plant is installed. Bituminous-coal gas producers are now obtainable.

They are the only apparatus that will deliver a hp-hour from 1 lb. of coal. While the first cost of a producer-gas engine will slightly exceed the cost of a steam boiler and engine, the saving in fuel alone during the first year will more than pay the difference in investment.

In the discussion of this paper numerous questions were asked of Mr. Adams regarding the operation of the plant in which he is interested. He said that two engines have been in operation since April, 1907. When first installed the ignition system and other things gave much trouble. It has been found. however, that as long as eternal vigilance is exercised, no serious trouble is encountered. Gas engines are as reliable as steam engines if nothing breaks, but no amount of care will guard against occasional breakage. The gas is ignited from the exciter circuit through lamps and also from a set of storage batteries. Mr. Adams said that the plant, which has a peak load of 375 kw, operates with three men for the 24 hours. As to comparative depreciation of gas and steam plants, Mr. Adams remarked that two engines had been running for over four years with very little repairs. Of course, they had received proper attention. One fault of the gas engine is that its operation is so uniformly good that the engineers become lazy. With a good man in charge there is no reason why a gas plant should not last as long as a steam plant.

Private Plants in Central-Station Territory.

A paper discussing means for overcoming private-plant competition was read by Mr. B. H. Gardner at the recent convention of the Ohio Electric Light Association. The existence of private plants was attributed to excessive rates charged for central-station service and to the lack of healthy co-operation between the central station, the local contractors and the large manufacturing companies. The local contractors may be of great assistance to the central station, and, on the other hand, they may be a stumbling block in the way of much new business. They are naturally in a position to hear of many new concerns, to hear of proposed changes in motive-power equipment, and are often asked to bid on this new work before the central-station representative could learn of the matter. It is easy to see that if the contractor had the proper feeling for the central station and would notify the manager or contract agent of all the various moves of which he has knowledge, much valuable business would be acquired. On the other hand, much of this business will probably be lost if the contractor has a grudge against the central station, and spreads the belief that its rates are high, its treatment of the public unfair, and the best thing to do would be to install a private plant and be independent of the lighting corporation, etc. Experience has proved that the good-will of the contractor is a powerful asset and that he can make a most valuable booster for central-station service; but in order to get this hearty co-operation, and the benefit of this boosting, the central station must stand ready to do its full share. It is not reasonable to suppose that the contractors as a whole will be very enthusiastic central-station boosters if the central station interferes with their business by selling fans, heating apparatus and supplies at cost, if it does wiring at cost, or near it, or if all of the business the central-station representative can give out is thrown to some one contractor.

What has been said of the local contractors as valuable allies applies with equal force to the electrical manufacturing companies. They, even more so than the contractors, are called upon to bid upon new machinery, motor equipments, etc., many months before the plans are made public, and usually before the central-station representative could possibly learn of these things. It is easy to see the benefit that would come from having the hearty co-operation of these companies, for in addition to being posted on all such new concerns, contemplated changes in equipments, etc., the representatives of these companies often make quiet but effective boosters for central-station service. The central station should be, and usually is, the largest purchaser of electrical apparatus in the territory which it serves, and all of the electrical manufacturers are naturally very anxious to receive their share of this business. Moreover, the motor business which a wide-awake central-station manager can turn over to the manufacturers in the course of a year will largely outbalance the few private generating plants they might install in competition with the central station.

To cause a private plant to be abandoned after the plant has once been put into operation is usually a very difficult task, especially as long as the operation is fairly satisfactory. The successful merchant or manufacturer will not abandon his plant simply because the central-station representative tells him it will be better or cheaper for him to do so. He must be shown wherein it will be better, and figures must be produced for proving that it will be cheaper. To obtain these figures it is often necessary to make an actual test on the premises, determining the kw-hour consumption, cost of coal, cost of labor and all other items that enter into the finished cost. For many small plants such a test will show a rate for energy so high that it may easily be closed down without further trouble. For the larger plants the cost is often more nearly that of the central station itself and, of course, the margin to go on is not so large. However, there are few owners of plants that are not willing to pay 10 or 15 per cent more for energy for lamps and motors in order to rid themselves of the annoyance of a plant. Knowing the cost of operating a private plant it is largely a matter of meeting this price and discussing arrangements with its owner until it is finally closed down. Of course, this is much easier said than done, but it can be done by putting in appearance at an opportune moment after some break-down or serious trouble, for such trouble is bound to come sooner or later to every private plant. Or, if no mishap occurs, the owner of the plant may often be persuaded to close the plant down for a year, during this period using the central-station's service, in order that he may determine the desirability of purchasing energy rather than attempting to generate it himself If necessary, it is advisable to take this business for a year's trial at a flat rate—this flat rate to be determined by the private plant cost of the previous year. At the end of the year's test a long-term meter contract may be entered into at whatever rate the test shows the consumer is entitled to, and there are not many people who will go back to a private plant after a year's use of reliable and satisfactory central-station service.

It is often the case that private plants, especially lighting plants in business sections, supply energy for lamps in adjoining buildings. In making tests on such plants it is always wise to meter the consumption through these circuits. Often the parties buying energy from a private plant are the victims of high flat rates, defective meters and the manipulations of meter readings, inefficient lighting units, etc., and it is easy to take away much of this business from the private plant.

Many small lighting plants may be closed down by the central station recommending some more efficient system of lighting. Consider, for instance, a store lighted with clusters of carbon-filament lamps, or old-style arc lamps. As long as this system of illumination is adhered to, it may be impossible for the central station to get the business; but if it will recommend or even furnish the first installation of tungsten lamps, a satisfied consumer and valuable business may be secured without much trouble or expense.

In the case of a private plant that is supplying energy to motors, it is just as important that a thorough test be made showing the finished cost per kw-hour, as in the case of a lighting plant. Such a test is often all that is necessary to take over the business, and for those plants where the cost is near the delivered cost of the central station the same tactics may be followed as were outlined for the lighting plant. Many small power plants may be closed without a great deal of trouble by the central-station representatives pointing out a more economical arrangement of line shafting, subdividing the load, and in other ways cutting out useless friction, and making energy as purchased from the central station much cheaper and more convenient. It is often desirable, where the central-station representative is sure that a saving can be effected, but where the

prospective customer has his doubts and will not risk the investment without being assured as to the costs of operation, for the central station to loan the necessary motor or motors for a 60- or 90-day trial, so as to prove the point. In these cases it is better to let the prospective customer stand the expense of installing the apparatus, but if necessary it is good policy for the central station to assume one-half, or even all, of the cost of installation. Where it is necessary for the central station to assume all of the risk a written proposition should be made to the prospective customer offering to furnish and install a motor of certain horse-power, speed and make for a reasonable length of time, it being specified that if at the end of this trial period the service and the cost of operation are satisfactory, the central station is to be reimbursed for the cost of the wiring and for the motor itself, the exact cost of each being set forth. Of course, it is not advisable to make such a proposition to every prospective customer, and great care and judgment should be exercised to make sure that an unfair advantage is not taken of the offer. It will be found, however, that a judicious use of such trial propositions will result in the securing of much valuable business that would hardly be secured in any other way.

Such trial propositions, valuable as they may prove in closing down existing plants, are even more valuable in keeping private plants from being installed initially. Often a manufacturer in erecting a new factory is in doubt as to his motor equipment and will gladly receive suggestions from the central-station representative as to the horse-power requirements, best methods of arranging machinery, line shafting, etc. In this way it is often possible for the central station to equip a new factory with motors and have them so arranged as to get the best economies, with the understanding that the factory will operate with central-station energy for three, six or 12 months, until demand, load factor and rate can be intelligently determined. In small shops and factories it is even advisable to loan the motor or motors and, if necessary, do the wiring.

A medium-sized central station has consistently followed a course, as mapped out in this paper, for two years. During these two years, gas and steam-driven plants have been displaced by central-station service, the aggegate rating of such plants being more than 1500 hp, while about an equal amount has been added to the connected load in new buildings and factories, where the owners first considered some other form of energy. The central station that has never adopted such a policy will find that it pays to do so.

INTERIOR WIRING AND ILLUMINATION

Wiring Old Houses.

It is an encouraging sign that along with greater activity to secure wiring of residences by electrical contractors, there is an increasing realization of the necessity of doing such work as is offered in a manner which will cause the public to forget the old idea that the wiring of an old house necessarily creates a confusion second only to moving. The up-to-date contractor on residence wiring employs gentlemanly wiremen for this class of work, who appreciate the importance of making as little muss as possible, and of cleaning that up when through. A very good man on overhead work outdoors may be entirely unfit for the wiring of finished houses, and may create as much havoc and consternation as the proverbial bull in a crockery shop.

A Heavy-Conductor, Open-Work Installation.

By Arthur Gillman.

It is considered best practice, in industrial-plant installations, to erect all electrical wiring in the most substantial and rugged manner. Preliminary to the installation of any work costing over, say, $100, a study is made for ascertaining the most economical (maintenance considered) method of locating the conductors. Thought is given to and provision made for the future, so that, upon the completion of a job, there is a very reasonable assurance that it will be a fixture for many years. In view of this contemplated permanency the electrical construction should be of as enduring a character as the mill buildings themselves.

Interior conductors smaller than No. 0000 B. & S. gage are preferably placed in wrought-iron conduit. Larger ones are so encased, where there is probability of their being interfered with, but in instances where interference is improbable, the more inexpensive open-work is the rule. Below there is given a description of a first-class open-work installation. The fittings

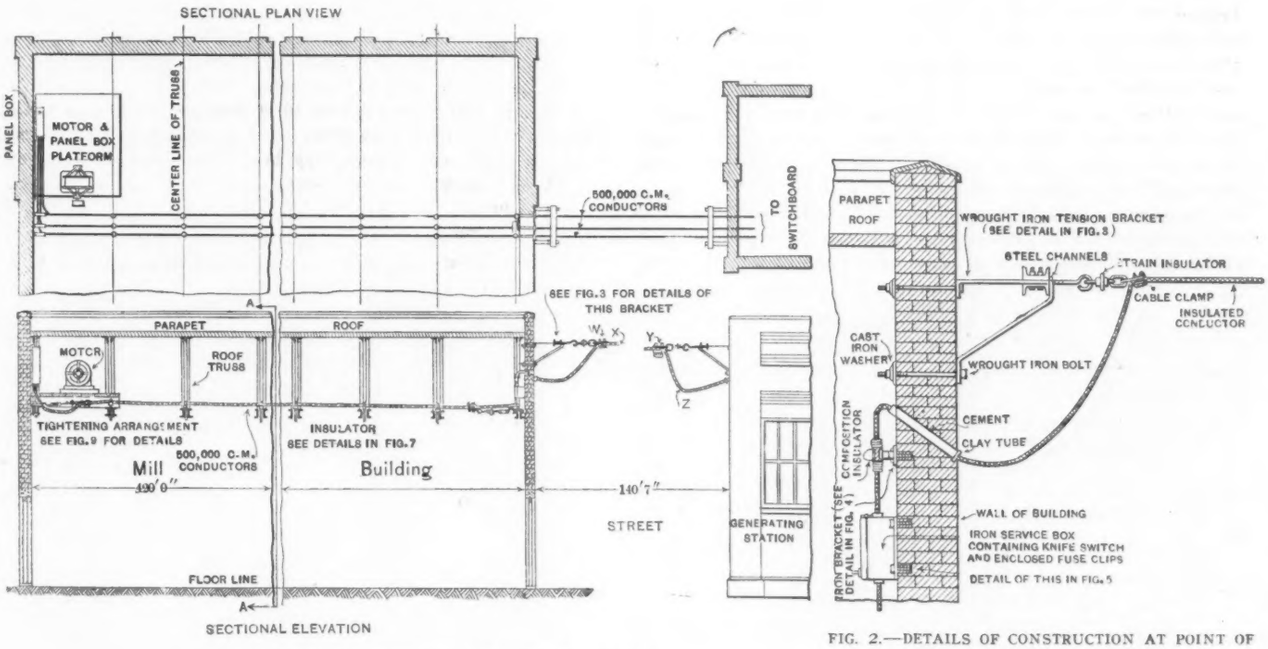


FIG. 1.—SECTIONAL VIEWS OF THE INSTALLATION.

FIG. 2.—DETAILS OF CONSTRUCTION AT POINT OF ATTACHMENT TO BUILDING.

used will be taken up first and then the method of stringing the wire.

Fig. 1 shows the conditions that were to be met and, in a general way, indicates the devices adopted for supporting the conductors. The feeder, composed of three 500,000 cm triple-covered, weatherproof, stranded conductors, was extended from its own feeder panel at the switchboard in the generating station across a street (140 ft. 7 in. wide between buildings), and the entire length of a steel and brick mill building 420 ft. long. At the distant end of the mill building the feeder was led into a steel-clad panel box, from which branch circuits to one large and several small three-phase, 60-cycle induction motors were run. All of the motors were concentrated near the end of the structure so that the end wall provided a logical support for the panel box. A wooden platform was built on the roof trusses,

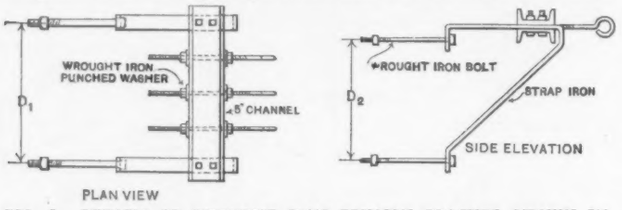


FIG. 3.—DETAILS OF WROUGHT IRON TENSION BRACKET SHOWN IN FIG. 2.

on which the large motor was set, and the panel box was so located that a workman by standing on the motor platform could conveniently attend to it.

The three conductors extended through the wall of the generating station in clay tubes and were supported, on either side of the street, by tension brackets, which are shown in detail in Figs. 2 and 3. Construction similar to that illustrated in Fig. 2 was used for the attachment at the generating station wall, except that the service box was omitted. A detail of the tension bracket ironwork is given in Fig. 3. All of the materials composing it are common commercial articles, except possibly the 4-in. channels. Sturdy strips of wrought iron could, doubtless, be substituted for these if necessary, but in the instances under description the channels were available and therefore used.

The brackets were made in the company's blacksmith shop from rough sketches furnished by the electrical superintendent. Although not shown in Fig. 3, strain insulators were inserted

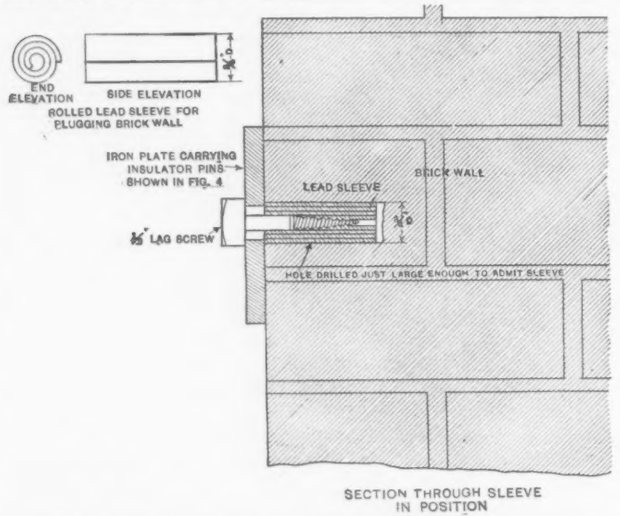

END ELEVATION
SIDE ELEVATION
ROLLED LEAD SLEEVE FOR PLUGGING BRICK WALL
IRON PLATE CARRYING INSULATOR PINS SHOWN IN FIG. 4
BRICK WALL
LEAD SLEEVE
⅝" LAG SCREW
HOLE DRILLED JUST LARGE ENOUGH TO ADMIT SLEEVE
SECTION THROUGH SLEEVE IN POSITION

FIG. 5.—METHOD OF ATTACHMENT TO BRICK OR STONE WALL.

into the eyes of the strain bolts by the blacksmith. The strain insulator, a market commodity, is constructed of hard, durable insulating material and malleable iron. A fair idea of its structural features may be obtained from the plan and elevation in Fig. 9. After assembling in the blacksmith shop, the dimensions D_1 and D_2 (Fig. 3) were carefully observed, and equal dimensions were laid off in their correct locations on the brick wall on the *inside* of the mill building and generating station. Holes, to accommodate the supporting bolts, were then drilled from the inside outwardly. By standing on the roof and leaning over the parapet wall a man guided the tension bracket, which was held by a rope, to its place and pushed the supporting bolts into place from the outside. The washers and nuts were adjusted by a helper on the inside. By this procedure the erection of a temporary scaffolding and platform on which the man might stand to drill the holes for the supporting bolts was avoided. On the inside it was necessary merely to put a couple of planks across the roof truss bottom chord to provide a sufficient working footing.

When drilling through a brick wall from the inside toward the outside it is necessary to work with considerable care when the drill is almost through. If the drill be pounded too strenuously, there is a strong probability that an entire brick—maybe several, if the bricklaying is not well done—will be knocked from the outer face of the wall, leaving an ugly spot and making a

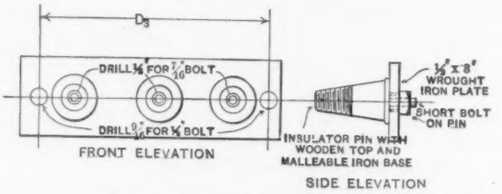

DRILL ¼" FOR ⅞" BOLT
DRILL 9/16" FOR ½" BOLT
FRONT ELEVATION
¼" x 8" WROUGHT IRON PLATE
SHORT BOLT ON PIN
INSULATOR PIN WITH WOODEN TOP AND MALLEABLE IRON BASE
SIDE ELEVATION

FIG. 4.—IMPROVED THREE-PIN WROUGHT-IRON BRACKET.

disagreeable place to patch. By tapping the brick drill gently through the outer 3 in. or 4 in. of the wall the difficulty outlined above may be avoided.

Holes for the three clay tubes (Fig. 2) were drilled—pointing downwardly, so that drip loops would be formed in the conductors—from the inside of the mill building, as described above. The diameter of the holes, through the brickwork, was made about a quarter of an inch greater than the outside diameter of the tubes. The tubes were inserted in the holes, the heads being on the outside, held in place temporarily with small wooden wedges, and neat cement mortar was then poured around them. The cement provided an effective and permanent bond between the tubes and the brickwork. The head of the tube was placed on the outside because the swaying of the conductor is less likely to crack it than the plain end and, furthermore, the head affords a better appearance outside than the other end.

A three-pin bracket, shown in Fig. 2 and detailed in Fig. 4,

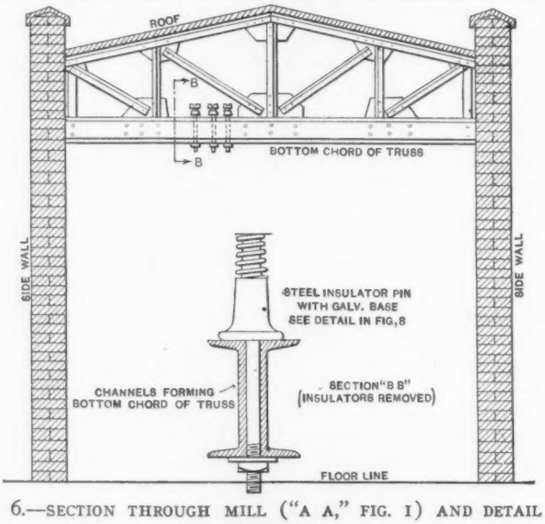


FIG. 6.—SECTION THROUGH MILL ("A A," FIG. 1) AND DETAIL OF PIN ATTACHMENT.

was made in the blacksmith shop. The same kind of pins were used in it as those used for the "run" in the mill building. This pin is delineated in Fig. 8. It was necessary, in adapting the pin to the wrought-iron bracket, to cut off all the stem except about 1¼ in. and to thread this 1¼-in. length. The construction of the entire appliance is obvious from Fig. 4. Small cavities were chipped from the brick wall, into which the nuts and the projecting portion of the pin stem fitted, enabling the wrought-iron plate to rest snugly against the brickwork.

The method of attaching the bracket with lag screws is indicated in Fig. 5. Two holes, ¾ in. in diameter, were drilled at the distance D_3 (Fig. 4) from center to center, into the wall, slightly deeper than the length of the lag screw to be used. Strips of sheet lead, 1/16 in. thick, about as wide as the depth of the hole, were rolled into hollow cylinders, as shown in Fig. 5. The lead cylinders, one in each hole, being in place, the lag screws were turned into them, expanding the lead sleeves sufficiently to provide a firm fastening.

Between the two channels forming the bottom chords of the

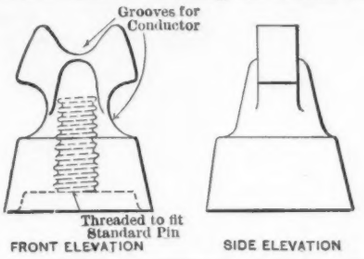


FIG. 7.—TYPE OF COMPOSITION INSULATOR USED.

mill building roof trusses, pins, such as that shown in Fig. 8, were secured in the manner indicated in Fig. 6. Three pins, one for each of the conductors, were set in each truss, and composition insulators of the type shown in Fig. 7 were screwed on. The truss gusset plates were ½ in. thick, which allowed the 7/16-in. stems of the pins to fit between them with a comfortable working clearance.

Pins, such as that shown, are carried regularly in stock by the supply dealers. The type illustrated is designed to support glass or porcelain insulators, its wooden top providing a yielding foundation for these brittle materials. An all-metal pin is manufactured of the same dimensions as that shown. Its threaded portion and base are of either black japanned or galvanized malleable iron and the stem is of wrought iron. This all-metal type would have been the proper sort to have used, with the composition insulators, in this installation, but the wooden-top variety happened to be in stock and was, therefore, utilized.

Glass insulators frequently cause trouble when attached to rigid supports, such as roof trusses, and loaded with heavy conductors. When imperfectly annealed changes in temperature

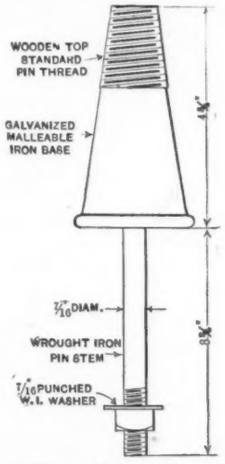


FIG. 8.—IRON BASE, WOODEN TOP PIN.

cause them to crack, and even if installed in some apparently unexposed location they are broken by pipe fitters or other workmen engaged in mill maintenance. These same objections hold, but to a lesser extent, in the case of porcelain. For these reasons, composition insulators are used in the plant in which the described installation was made. The form chosen is shown in Fig. 7. The composition of their component materials does not appear to be generally known, and doubtless different manufacturers employ different formulas, but of the ingredients flaked mica and asbestos fiber are conspicuous in certain brands. These are bound together with some plastic dielectric and molded into shape by pressure, heat probably being applied simultaneously, which transforms the doughy mass into a tough, smooth-surfaced insulator. Conductors may be placed either in the top or the side groove of the insulator illustrated in Fig. 7. In the case under description the wires were held in the top groove, as in no case was there a side strain on an insulator.

Details of the tightening arrangement, used to pull the slack from the long sections of conductors and to hold them taut, are given in Fig. 9. The device was assembled in the blacksmith shop and all of it was built there except the turnbuckle, strain insulator and cable clamp, which were purchased from a supply dealer. The sketch makes its construction and application obvious. The strain insulator is guaranteed by its manufacturer to sustain a load of 8000 lb. On the inner surfaces of the two components of the cable clamp are small pointed projections, which, upon the clamping bolts being tightened, dig into the bare copper conductor and serve to reinforce the grip caused by the clamping action. After erection, the bare metal clamp, the link and the adjacent eye of the section insulator should be covered with friction tape to prevent an accidental contact or short-circuit. The wrought-iron bolt which clamps the channel grip to the channels is of use before a tension is put on the conductors in preventing any tightening arrangement from slipping along the channel or coming in contact with its neighbor.

Subsequent to the placing of all of the supports, the conductors were loosely strung, first from the generating station, across the street, and into the iron service box, shown in Fig. 2, and then along the mill building trusses. At the generating sta-

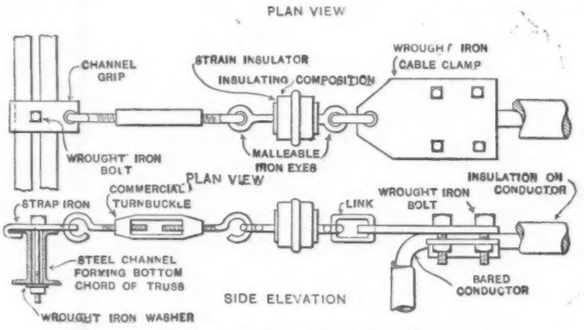


FIG. 9.—DETAILS OF TIGHTENING ARRANGEMENT.

tion end, the three conductors were soldered into their proper lugs at the back of the switchboard feeder panel and tied to insulators, not shown in the illustrations, on the inside of the generating station. Enough slack to form a reliable drip loop was allowed to hang at the point *Z*, Fig. 1, and the cable clamp *Y* was made fast. A spare cable clamp was then fastened to the conductor at *X*; and with a block and tackle men on the ground pulled much of the slack from the span. Both of the strain bolts being extended to their limit, the permanent cable clamp *W* was affixed and the temporary one removed. By adjusting the nuts on the tension bolts, the proper amount of sag was permitted to hang in the span. It is not desirable that conductors be too tight, as an unreasonable strain is brought upon the fittings, which may be magnified by temperature changes.

The three lengths of wire in the mill building were tightened in substantially the manner just described, the turn-buckles serving as tension adjusters. The conductors were tied at each insulator with a length of No. 6 B. & S. gage, triple braid, weather-proof wire, merely to prevent them from being pushed from the groove. The tie wires were subjected to no longitudinal strain, all tension in the conductors being taken by the tightening arrangements.

The iron service box shown in Figs. 1 and 2 is a regular stock article with supply dealers and was purchased fitted complete with single-throw, triple-pole knife switch and National Electrical Code fuse clips. Obviously its function is to provide a means of interrupting all electrical connection with the generating station in emergency or while repair or construction work is being done.

Composite Arc Electrode.

A patent was granted Sept. 1 to Charles F. Lindsay, of Schenectady, N. Y., on a composite arc electrode made from a mixture of iron and titanium oxide, which is treated to convert the iron oxide into metallic iron and more or less reduce the titanium oxide. An intimate mixture containing 70 parts of the magnetic oxide of iron, 30 parts of rutile and 1 part of potassium carbonate is first formed. This is then moistened with a fluid binder until it becomes plastic and then molded into cakes or balls, or squirted into pencils. The cakes, balls or pencils thus formed are placed in crucibles surrounded with powdered coke, which are placed in furnaces and fired for some time at a temperature of about 1200 deg. C. Owing to the temperature employed, and other conditions, the iron is more affected by the reducing action than is the titanium, much of which is probably reduced to the suboxide, though probably some part is reduced to the metallic state. The more or less reduced material formed is then reground and again thoroughly mixed and rendered plastic by the addition of a suitable fluid binder which may consist of glycerine mixed with water. From the plastic mass pencils are molded, squirted or pressed in any suitable manner. The pencils thus formed are first dried at a temperature of about 200 deg. C. to remove practically all of the moisture, after which they are packed in powdered coke in crucibles and again fired at a temperature of about 1200 deg. C. for some time. After this last firing the electrodes are allowed to gradually cool, and then polished or brushed in any suitable manner to remove particles of coke which may adhere thereto. In the electrodes thus formed the titanium and iron are probably not in a chemical combination, but the titanium may perhaps be said to be held in suspension in the reduced iron. The electrodes are very homogeneous and possess considerable mechanical strength. Their electrical conductivity is very good in any case, owing to the reduced iron contained in them, and they give a steady, flaming or luminous arc yielding a great amount of light of a very good color.

New Telephone Patents.

IMPROVED TRANSMITTER.

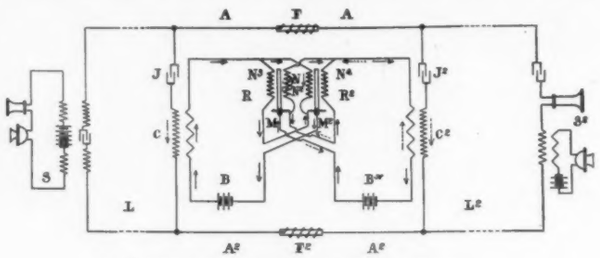
With all of the commoner forms of transmitters mounted upon an adjustable arm it is possible to place the transmitter in a position of great inefficiency even though still in a position convenient for use. This position is one wherein the electrodes approach the horizontal plane. With a view to reducing this difficulty, Mr. E. J. Pitrat, of Urbana, Ill., has designed a transmitter with the plane of the electrodes perpendicular to that of the diaphragm and parallel to that of the face of the mouthpiece. A bell crank lever serves to connect the movable electrode with the diaphragm and the long arm is upon the electrode side so as to increase the electrode movement.

RECEIVER SUPPORT.

A receiver support has been patented by Mr. F. Simons, of Buffalo, N. Y. It consists of a clamp for attachment to the transmitter arc, carrying a lug on one side. This lug is drilled vertically to receive a wire form. This wire is bent to hold the receiver in proper relation to the transmitter. At the lug, the horizontal part of the wire normally rests in a notch in the lug, but when the rest is not required, by raising it out of the notch it may be turned back out of the way.

TELEPHONE REPEATER.

In the accompanying illustration there is shown an improved repeating circuit, the invention of N. G. Warth, of Columbus, Ohio. The cut shows the intermediate repeating station and two originating stations. With this set the main line is divided into two talking sections by the use of the choke coils *F-F2*, which are located at the repeater station. The repeaters, of which there are two associated, are arranged in a local circuit, their only connection with the line sections being by means of the induction coils *C-C2*. The receiver part of each of the repeaters is double wound, the two windings being connected so as to have a neutralizing effect upon the instrument for all repeated currents. Suppose a current impulse arrives from transmitting station *S*, it will be impressed upon the repeater circuit at the induction coil *C*. Tracing the current in accordance with the solid arrows it will be seen that it divides between the coil *N3* of receiver *R* and *N2* of receiver *R2*. The currents combine at the diaphragm of the transmitter part *M2*, the circuit thence being completed through the battery *B*, both repeaters being agitated. The currents set up by transmitter part *M* arising from battery *Bx* affect the coils *N* and *N4*, while



WARTH TELEPHONE REPEATER SYSTEM.

those set up from battery *B* affect the coils *N3* and *N2*. The result is a neutralization at both receiver parts, as far as the repeated currents go. At the two induction coils *C* and *C2*, however, there arises the full effect from the currents from the batteries *B* and *Bx*. This action results in a full transmission forward toward the called station *S* and backward toward the transmitting station *S2*. It will be seen, however, that interference in the local circuit has been done away with and that, furthermore, the balance necessary for the overcoming of interference lies practically wholly in the local parts at the repeater station, the existence of other line sections being immaterial.

Letters to the Editors.

Symbols for Physical Quantities.

To the Editors of Electrical World:

Sirs:—I have noticed with much interest the various notes and communications which have appeared in your columns relating to proposed changes in symbols of physical quantities as originally outlined by Mr. Miles Walker. I also note in the Aug. 29 issue, page 460, that Mr. C. C. Garrard advocates the Esperanto method.

I wish to add my hearty endorsement of this plan. As more and more scientists, engineers and professional men are studying Esperanto, so more and more technical words are being added to the language. In doing this the greatest of care has been exercised in selecting roots most representative of the common European languages. Anyone can write to the committee having this matter in charge suggesting appropriate Esperanto words for technical words or terms, but persons familiar with technical words of various languages are specially invited to contribute their suggestions relative to new technical words. After due deliberation based on many letters and suggestions from persons of different languages, the committee is gradually forming the technical words of this auxiliary international language.

By the continuation of such a conservative policy an international system of symbols can be developed, but a special committee of eminent scientists and engineers of different countries should be the court of last appeal to which all suggestions should be referred. With this accomplished, the value of a speaking and reading knowledge of Esperanto would be of immense value to scientists and professional men, and in addition to the scientific Esperanto journals now published, there would no doubt be many Esperanto journals dealing exclusively with different professions, which would have a large circulation all over the world.

In point of economy, the adoption of a universal auxiliary language appeals to engineers. If in his preparatory course

foreign languages were omitted and Esperanto substituted, he would, with a knowledge of only two languages, be able to accomplish more than he can now with a superficial knowledge of several.

PITTSBURG, PA. HENRY W. FISHER.

Ward Leonard System of Motor Control.

To the Editors of Electrical World:

SIRS:—In your issue of Aug. 1, 1908, Messrs. Crocker and Arendt in referring, on page 229, to the application of the Ward Leonard system of motor control, state that the most extensive use is in the operation of turrets and gun platforms, and add that it is now used also for driving of rolling-mill equipment. It is of interest to note that the incentive for the rolling-mill drive was the great success met with in Europe through the use of fly-wheel converters with Ward Leonard control in connection with the electrical drive of large hoisting engines. The importance of this application is apparent from the fact that two German electrical concerns have furnished and on order within the last six years about 150 main hoists operated by fly-wheel converters, the larger hoist equipments up to 2600 hp each. The size of most of the rolling-mill equipments is still greater, as may be seen from the accompanying table, which gives a list of the rolling-mill equipments built by, or under order with, the Allgemeine Electricitäts Gesellschaft and the Siemens-Schuckert works, up to the end of 1907. A further application of the Ward Leonard control is to driving paper machines, the speed of which must be varied over a wide range in order to comply with the stringent requirements of operating conditions. A neat application is to the drive of the carriage which tows ship models in the ship-testing plant at Uebigau, near Dresden.

No.	Mill	Tons Output per Kw.	Roll Motor		Flywheel Converter	
			Hp. Mean/ Max.	R.P.M.	R.P.M.	Flywheel No./ Tons W't Each
1	Struct'ral steel	16.5	3600/9000	±110/140	375	2 x 28.6
2	" "	22	3600/9000	±110/150	417	2 x 28.6
	Billet; gear 2:1	33–38.5	3600/9000	±110/150	417	2 x 28.6
3	Plate	30	3600/9000	±110/150	417	2 x 28.6
	Universal	.....	3600/9000	±110/100	417	2 x 28.6
4	Billet	66/77	5000/12500	±120/160	300	4 x 27.5
5	Slab	22	2500/6250	±120/160	405	2 x 28.6
6	Billet	4.4	1500/3750	±110/140	400	2 x 22
7	Struct'ral steel	11	1200/3000	±110/160	450	2 x 22
8	Bloom	55	/7000	± 60/90	450	1 x 38.5
9	"	82.5	/8400	± 40/60	450	1 x 41.8
10	Tube	.....	800	±250	500	1 x 41.8
11	Copper	3.3	900	±120	750	1 x 5.5
12	Bloom	39.6/19.8	9000	± 80/140	375	2 x 38.5

I assume from the editorial in your issue of Aug. 9, page 280, that you are under the wrong impression as to the Ward Leonard locomotives being still in operation, as, in fact, the motor-generator has been removed from the locomotive, which is now operated as a straight single-phase machine. The whip-bow current collector used consists of a very light 15/16-in. steel tube, slotted to receive the actual current collecting part, which consists of a piece of trolley wire of figure 8 cross-section, secured by a few bolts only, thus facilitating the quick exchange when worn. The heavy Siemens-Schuckert locomotive is to be considered in the light of a trial machine in selecting the proper equipment for the electrification of the famous Gothard tunnel.

BERLIN, GERMANY. EUGEN EICHEL.

Motor Control.

To the Editors of Electrical World:

SIRS:—Replying to Mr. H. M. Martin's remark in your issue of Aug. 22, in relation to a special controller-arm brush used when accumulators are employed for motor starting and speed control, I wish to say that the article in the issue of Aug. 8, to which Mr. Martin refers, mentioned controller details only when necessary to explain the motor part of a printing-press equipment.

A second article, which I understand is in type, covers the brush arrangement to which Mr. Martin refers.

TENAFLY, N. J. S. H. SHARPSTEEN.

Silico-Vanadium Steel.

To the Editors of Electrical World:

SIRS:—In reading my article entitled "Silico-Vanadium Transformer Cores," I note that a stenographic error has crept into the latter part of the article in that the word "not" has been omitted in the clause reading "While the limits of the possibilities for silico-vanadium steel *have been reached*," which should read "*have not been reached.*" The reading of the remainder of the article renders the error quite obvious, but in view of the importance of this subject to the users of transformers, it is quite essential that the facts of the case be clearly understood.

Exhaustive tests now in progress indicate that even the low core losses now secured by the use of silico-vanadium steel will be materially reduced within a comparatively short time, and I wish to emphasize the fact that the limits have not as yet been reached.

CHICAGO, ILL. H. W. YOUNG.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Series-Repulsion Motor.—R. RICHTER.—The conclusion of his article illustrated by diagrams in which the author criticises the series-repulsion motor of Alexanderson and compares it with other types of single-phase motors. He discusses in detail the spark voltage at different loads for the different types of motors. He concludes that Alexanderson's motor has very valuable properties and will find a place in practice with the other commercial single-phase motors, but that it is not superior to the series motor with a constant auxiliary field. When in the discussion of the American Institute of Electrical Engineers at Niagara Falls a frequency of 25 cycles per second was considered to be the best for traction, this conclusion was reached on the assumption that the Alexanderson motor has such ideal properties that it would be as suitable for 25 cycles per second as other single-phase motors for a frequency of 15. This assumption, however, is wrong, and the author concludes that the frequency of 15 cycles is undoubtedly the best for single-phase traction.—*Elek. Zeit.*, Aug. 27.

Condenser Action of the Synchronous Motor.—A synchronous motor is capable of drawing a large leading wattless current from the mains provided it is sufficiently over-excited. The anonymous author calculates the rating of a synchronous motor required to raise the power factor of a system to unity, or to 95 per cent, and discusses also the case in which the motor is made to do mechanical work in addition to raising the power factor.—Lond. *Elec. Rev.*, Aug. 21.

Iron Losses in Direct-Current Armatures.—W. KEHSE.—An

illustrated article describing a modification of Hobart's method of calculating the iron losses. The method enables one to find quickly the values of the iron losses of direct-current and alternating-current machines with sufficient accuracy. Some examples show the agreement of the calculated values with the measured values.—*Elek. Zeit.*, Aug. 6.

Lamps and Lighting.

Metallic-Filament Lamps.—An account of the extended discussion which followed the presentation of a paper by Remane at the recent annual meeting of the German Assoc. of Elec Eng. The paper dealt with the effect of voltage variations on the life of metallic-filament lamps, but has not yet been published in full. The connection of metallic-filament lamps in series was discussed at some length. The difficulty of this arrangement is that the filaments must be designed for exactly equal currents. This is a great disadvantage of series connection compared with connection in parallel. But since 220-volt lamps have a higher specific consumption than 110-volt lamps of the same candle-power, it is preferable to use two 110-volt lamps in series whenever the cost of energy is high. For this purpose it is important to sort the lamps carefully in the factory. The practice in the case of osmium lamps is as follows. In manufacture on a large scale from 50 to 60 per cent of the lamps produced differ from the desired value. All of the lamps are then sorted in three classes according to the normal current. For the osram lamps the German Welsbach Company uses a similar method, and has introduced a certain method of notation for the practice. The 32-cp lamps for parallel connection are marked "32 cp." For series connection the 32-cp lamps are sorted into three different classes, according to the current, and these three classes are marked "30 cp," "34 cp" and "36 cp" according to the current. A user of these lamps must always order lamps marked in the same way, and will then get lamps which are suitable in current as well as in voltage. Experience has shown that under such conditions 110-volt osram lamps are just as good for series connection as they are for parallel connection. Some years ago troubles were experienced with osmium lamps at certain points of the network. An investigation showed that at the points of trouble the e.m.f. was not normal, namely, 120 volts, but higher, up to 136 volts. When this had been determined once for all, the proper lamps for the higher voltage were installed and all complaints ceased. It is important to measure the voltage at different points of the network and to order the lamps according to the existing voltages. It is in the interest of central stations to assist the lamp manufacturer in this direction. It was further emphasized in the discussion by Remane that all his life tests of osram lamps had been made with alternating current and that the lamps had been found just as good for alternating current as for direct current. Teichmüller claimed in a discussion that a 220-volt lamp cannot be as good as a 110-volt lamp. The 220-volt lamps require naturally a thinner, longer filament, which is necessarily more brittle; on account of the electrostatic effect the reduction of the cross-section is greater at high voltages than at low voltages. For these reasons Teichmüller concludes that a 220-volt lamp cannot have the same life as a 110-volt lamp of the same specific power consumption. Weltin said that experiments of the Wolfram Lamp Company have shown that 220-volt lamps have the same life as 110-volt lamps. Wedding confirmed this for 32-cp or 50-cp lamps; he stated, however, that there was a difference for 16-cp and 25-cp lamps. Blau objected that in the comparative measurements made between 110-volt and 220-volt lamps, lamps of exactly the same specific power consumption had not been used; 220-volt lamps are generally built for a little higher specific power consumption. The change of candle-power of an osram lamp with the e.m.f. can be well expressed by the 3.6 power of the voltage.—*Elek. Zeit.*, Aug. 20.

Osram Lamps vs. Small Arc Lamps.—An account of the extended discussion which followed Remane's recent paper before the German Assoc. of Elec. Eng. The paper itself was abstracted in the Digest last week. Various speakers claimed that in his comparison Remane had not considered the latest and most efficient types of small arc lamps and that the comparison seemed, therefore, unfair to small arc lamps. Remane insisted that he employed the last published data on arc lamps. Blau pointed out that even on the basis of the claims of the arc-lamp partisans 300-cp or 400-cp osram lamps are equivalent to small arc lamps of the same candle-power. Blau claims that they are commercially superior.—*Elek. Zeit.*, Aug. 20.

Arc Lamps.—The first part of what appears to become a long illustrated serial on recent improvements in arc lamps, based chiefly on patent specifications. The author first takes up open arc lamps with carbon electrodes. The feature of the constructions described rests chiefly in the regulating mechanisms.—*Zeit. f. Beleucht.*, Aug. 30.

Ultraviolet Rays.—F. C. Schanz.—A lecture demonstrating the effect of ultraviolet rays on the eye and especially the production of fluorescence of the lens of the eye.—*Zeit. f. Beleucht.*, Aug. 20.

Generation, Transmission and Distribution.

Norwegian Power Station.—A note of the Svälgfossen generating station in Norway. The Svälgfossen waterfall is situated in the Tinn River, some three miles north of Notodden, and about 38 miles from Skien, in the eastern part of Telemarken. So far the following two regulations have been completed: the Nosvand, about 50 sq. km water area, with a regulating basin of about 800,000,000 cu. m; and the Tinnsjoen, also about 50 sq. km water area, with a regulating basin of about 250,000,000 cu. m. The generating station is designed to yield about 40,000 hp. The station contains four main 10,000-hp turbines, and two exciter turbines of 500 hp each. The turbines are coupled direct to the four three-phase generators, which generate at 10,000 volts. The station, the dimensions of which, on account of the natural conditions, it has been necessary to limit as far as possible, is 11 m wide and 56 m long. In order to gain space, the equipment is so placed that the axes of the machine lie in the longitudinal direction of the station. From each turbine there is a delivery pipe down to a joint outlet. Electric energy is transmitted to the saltpeter works at Notodden, a distance of about three miles.—Lond. *Eng'ing*, Aug. 7.

Turbo-Alternator.—Results of tests of a 6000-kw turbo-alternator. Fig. 1 gives the actual curve of steam consumption for the range of loads from 2000 kw to 6000 kw. The actual readings have been corrected to apply to a super-temperature of 100 deg. Fahr. and a vacuum of 27 in. The figures of consumption do not include the energy used for driving the air-pump and circulating pump of the condensing plant, nor the excitation losses. The lowest consumption was 15.84 lb. of steam per kw-hour when the machine was developing 5650 kw.—Lond. *Elec. Eng'ing*, Aug. 27.

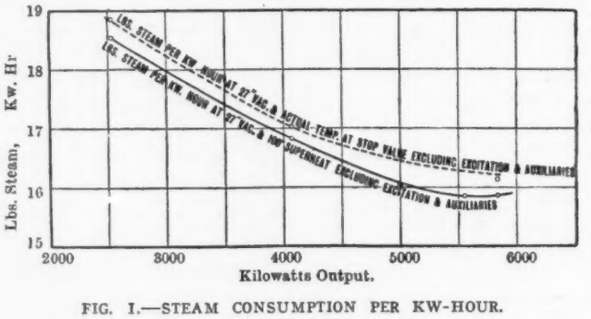


FIG. 1.—STEAM CONSUMPTION PER KW-HOUR.

Electric Motors in Ship Yards.—An illustrated description of the electric equipment of a British ship yard. Considerable use of electric cranes is made in the large roofed-in sheds, where steamships of very large size, such as the *Mauretania*, can be built. Electric motors are also used to a very large extent in driving special plate-punching machines and other appliances about the yard, many of which were specially designed for electric driving.—Lond. *Elec. Eng'ing*, Aug. 20.

Swiss Generating Station.—L. PASCHING.—An illustrated description of the Lucerne-Engelberg plant which utilizes a waterfall 310 m in height near Engelberg. Four 2000-hp generators have been erected which can supply energy at 50 periods; further a 600-hp generator, which acts as reserve for the electric railroad from Stanstad to Engelberg, and two 150-hp exciting generators. The e.m.f. of the generators is 6000 volts and is raised for transmission to Lucerne to 27,000 volts. The main transformer station, which is at Lucerne, is combined with the street railway converter station. Energy is also supplied to other towns located along the transmission lines. The construction of the switchboards is claimed to be especially elaborate and up to date.—*Elek. Zeit.*, Aug. 6 and 13.

Traction.

Single-Phase vs. Direct-Current Traction.—H. M. HOBART.—On the basis of results obtained with the single-phase equipment on several British railways, the author compares single-phase and direct-current systems. He emphasizes that it "is now established that complete single-phase equipments weigh in practice at about 40 kg per rated horse-power as against only about 16 kg per rated horse-power for complete continuous-current equipments." Were the weight of electrical equipments an inconsiderable percentage of the total weight moved, it would not necessarily be of grave consequence that single-phase equipments should be two and one-half times as heavy as continuous-current equipments. For long non-stop runs, there is but little reason to object to the single-phase system on the score of greater weight of equipment. But in non-long stop runs electricity, at the present stage of development, does not present economic advantages over steam for railway working. On the contrary, the field where railways can electrify their systems with great advantage is for routes with frequent stops. The belief of the single-phase advocates that the overhead construction would be comparatively inexpensive has also been proved to be in error. "The single-phase system is a splendid system—for a few Continental manufacturers and their representatives in this country."—Lond. *Times Eng'ing Supplement*, Aug. 12; *Elec. R'y Jour.*, Sept. 5.

Electric Traction.—A paper by J. N. Hatch gives a historical sketch of the development of electric railways, while a paper by W. E. Symons, entitled "The Passing of the Steam Locomotive," gives a review of the development of the steam locomotive with estimates as to the future increase of traction requirements and with special reference to local conditions in Chicago. "Chicago can never hope to be even reasonably clean nor to enjoy efficient interurban transportation service while she tolerates the smoke nuisance from 650 steam locomotives and about 12,000 chimneys of plants burning bituminous coal. The electrification of all steam railways, together with similar reforms in all stationary steam plants, is desirable; or in event of complete success not being practical or feasible, then the city should install plants to supply heat, power or light at a reasonable cost to those who either cannot or will not install and operate a smokeless plant."—*Jour. Western Soc'y of Eng'rs*, August.

San Francisco.—J. C. LATHROP.—A long and profusely illustrated review of the street railway system of San Francisco. The electric energy used by the United Railroads is generated in steam, gas and water stations. Only the steam stations, however, are operated by the company.—*Elec. Railway Jour.*, Sept. 5.

Paris.—L. DUBOIS.—An illustrated description of the extensions which are at present being made to the Paris subways. The River Seine has had to be crossed in two places, and a different method has been adopted in each case. The author gives full particulars of the interesting constructional work involved.—Lond. *Elec.*, Aug. 28.

Trucks.—P. DAWSON.—In a continuation of his long illustrated article on electric traction on railways, the author deals with the design of trucks suitable for geared motors. For railway work bogie trucks are almost universally used, and various types and makes are here described, those with pressed steel side frames being most in favor in this country. The method of suspending the motors and their position are also discussed.—Lond. *Elec.*, Aug. 28.

Installations, Systems and Appliances.

E.m.f. of Three-Wire Systems.—C. HEIM.—An article giving statistical data on the voltage employed in German central stations. It is shown that in the central stations which have been erected since 1900 the voltage at the consumers' terminals is far more often 220 than 110. In the new stations which are being erected, the proportion of those using the higher voltage is still increasing. But there is no urgent need for the high voltage in many villages and small cities. Further, the expectations based on the metallic-filament lamps can be fulfilled only when the voltage is not higher than 110. The author discusses the possibilities of using metallic-filament lamps on the higher voltage systems. For instance, two-wire, 220-volt systems can be changed into three-wire systems at 2 x 110 volts with moderate cost. Alternating-current systems are in a better position than direct-current systems. In new stations to be erected it will often be advisable to put some more money into the network in order to be able to make use of metallic-filament lamps.—*Elec. Zeit.*, Aug. 6.

South African Station.—An illustrated description of recent additions to the combined traction and lighting station of Durban. The additions consist of two turbo-alternators, each set having a rating of 940 kv-amp. The dynamo generates three-phase currents at 66000 volts with a frequency of 50 cycles per second. There are transformer and converter substations, one of which contains three 300-kw (6600-volt, three-phase to 550-volt direct e.m.f.) Peebles-La Cour motor-converters, each having an overload rating of 25 per cent and running at 500 r.p.m. The parallel running of the converters gives every satisfaction, any fluctuation in the load being very evenly taken up by the machines, which, being fitted with commutation poles, show no tendency to spark, with even very severe fluctuations. —Lond. *Elec. Rev.*, Aug. 21.

Scotch Central Stations.—Descriptions of the recently opened central station in Arbroath, Scotland. The steam-driven station has at present a 450-kw equipment, but extensions will be necessary in the near future. The supply is continuous current at 500 and 250 volts.—Lond. *Elec. Eng'ing*, Aug. 21.

Switchboard.—An illustrated description of a switchboard for a British steel works for the control of 3000 kw in direct current at an e.m.f. of 230 volts.—Lond. *Eng'ing*, Aug. 21.

Wires, Wiring and Conduits.

Zinc-Plated Iron Wire.—G. VIEL.—An article on the possibility of using zinc-plated iron wire as a substitute for copper wire on high-tension transmission lines. The results of comparative tests of a copper and an iron line with single-phase and polyphase currents are given in the form of tables and diagrams, from which the voltage drop in an iron wire with alternating current may easily be found. Direct-current calculations are easily made with the following figures: Zinc-plated iron wire has a resistivity of 11.65 microhms-cm at 0 deg. C; that is, 7.3 times the resistivity of copper of 97 per cent conductivity. This ratio changes slightly with the temperature, becoming 7.65 at 15 deg. C.—*L'Industrie. Elec.*, Aug. 25.

Fuses.—V. KLEMENT AND P. H. PERLS.—The report of a committee of the German Association of Electrical Engineers. Reference is made to the fact that the repairing of enclosed fuses is now being widely advertised. But tests of such repaired fuses, carried out before the committee, showed that the repairs are mostly of no value. If possible, repairs should be made only by the manufacturers of the fuses.—*Elek. Zeit.*, Aug. 27.

Transmission Poles.—An illustrated description of tar-coated cast-iron foundation pieces for wooden poles, made and used in Switzerland.—*L'Industrie Elec.*, Aug. 25.

Electrophysics and Magnetism.

Potassium Vapor.—R. W. WOOD AND T. S. CARTER.—A former study by Wood of the optical properties of sodium vapor has shown that our knowledge of the structure of the molecule

and of the mechanism of radiation may be increased by the investigation of metallic vapors at comparatively low temperatures. The authors have now investigated potassium vapor from the standpoint of its absorption, fluorescence and selective magnetic rotation of the plane of polarization. One of the most interesting facts brought out by these investigations is the close resemblance between the spectra of potassium vapor and the corresponding spectra which have been observed in the case of sodium.—*Phys. Rev.*, August.

Change of Color by Cathode Rays.—C. C. Hutchins.—An account of experiments on the effect of cathode rays in changing the color of certain minerals. The colorless and green varieties of fluorite are quickly changed by cathode rays to the amethyst variety. If the vacuum be high and the current weak, the change penetrates deeply into the mineral. With a lower vacuum or stronger current the penetration is not as deep, but the surface coloration is more intense. Similar effects were obtained with tourmaline and corundum. The action of the cathode ray in affecting mineral coloration brings to mind the recently discovered action of radium emanation upon the corundum minerals, and strongly suggests that some minerals have been changed while in the earth by radio-activity.—*Phys. Rev.*, August.

Conductivity.—J. Escard.—An article giving some general notes on the effect of various factors (as addition of impurities, change of temperature, etc.) on the electric conductivity of solids, liquids and gases.—*L'Industrie Elec.*, Aug. 25.

Silicon.—L. G. Wick.—Another article in his serial on some electric properties of silicon. After having investigated the thermo-electric behavior and the electric resistance of silicon, the author now deals with the Hall effect in silicon at ordinary and low temperatures, and adds some remarks on the relation between the Hall effect and thermo-electricity.—*Phys. Rev.*, August.

Electromagnet.—F. Emde.—A mathematical paper read before the Berlin Electrical Society. The author shows how the mechanical work done by electromagnets may be calculated by means of the energy principle and how it is possible to form concise conceptions concerning the magnetic energy. The magnetic energy may, for instance, be localized within the space. He concludes that the greatest part of the magnetic energy is not located within the iron itself, but within the air-gap.—*Elek. Zeit.*, Aug. 20.

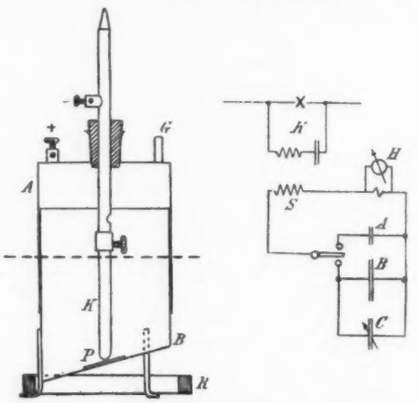
Electrochemistry and Batteries.

Rating of Storage Batteries and Temperature.—O. Hildebrand.—An account of a series of experiments with various types of storage batteries as to the effect of an increase of temperature on the rating. The results show that in view of the great difference in construction of modern batteries, it is impossible to state a general law for the change of rating with temperature and that for each type such an investigation involves considerable difficulties and time. The increase of rating with temperature depends on the age and the history of the accumulator. It also depends on the absolute value of the temperature. The increase of output per degree of temperature is greater at low temperatures than at high temperatures. The output of Planté plates increases less with temperature than that of pasted plates. Planté plates are more sensitive than pasted plates with respect to varying loads. A long lasting increase of temperature decreases the life of the accumulator, and should therefore be used only in exceptional cases; then an increase of output of at least 1 per cent per degree C. (at 15 deg. C.) may then be expected.—*Elek. u. Masch.*, Aug. 16.

Steel Hardening Furnace.—C. R. Straube.—An illustrated paper read before the German Association of Electrical Engineers describing an electric steel-hardening furnace of the Allgem. Elek. Ges. In its latest form it is operated by three-phase currents. It is possible to produce exactly within 10 deg. C. the high temperatures necessary for hardening high-speed tool steels. The articles are hardened in a fused salt bath throughout which the temperature is very uniform and can be exactly regulated. According to the temperature required the nature of the salt is chosen. For carbon steels potassium chloride is used; for high-speed tool steels barium chloride. For temperatures between 200 deg. C. and 400 deg. C. sodium or potassium nitrate is used; for temperatures from 1300 deg. C. to 1600 deg. C. fluorspar and magnesium fluoride. —*Elek. Zeit.*, Aug. 6.

Units, Measurements and Instruments.

Production of Continuous Oscillations; Tests of Condensers.—W. Burstyn and R. Leiser.—A description of experiments with continuous oscillations produced by means of the Poulsen arc without a magnetic field. The apparatus is shown in Fig. 2. There are two cylinders *A* and *B* of sheet iron, one sliding in the other; to close them air tight, the lower one is inserted in water up to the level indicated by a dotted line. The gas is introduced through *G* and leaves the apparatus through the vertical pipe inserted in the rubber stopper on the top. This pipe has a burner at the end where the hydrogen is burnt. The arc plays between the electrode *K* and the copper plate *P*. Illuminating gas is more effective than hydrogen. Acetylene gas is about as effective as hydrogen. Oscillations produced in this generator are not sinusoidal and they differ from pure sine waves the more the greater the capacity of the oscillations. In making measurements care must be taken not to observe a higher harmonic instead of the fundamental wave. The control consists in ascertaining whether the next shorter wave is half as long. In experiments with an oscillating circuit of about 5000 meters wavelength the hot-wire instrument was deflected at the following degrees of the dial of the adjustable condenser: 145 deg., 111, 88, 57, 46, 39, 33.5. The wave at



FIGS. 2 AND 3.—POULSEN ARC AND CIRCUITS USED IN COMPARING CAPACITIES.

145 deg. was determined to be the seventh harmonic. This may also be found by direct comparison of 145 deg. and 111 deg. For if 5 deg. (the zero capacity of the adjustable condenser) is added to 145 deg. and 111 deg., it is found that the two wave lengths have the ratio $\sqrt{150}$ to $\sqrt{116}$ or 8 to 7. In the same way 46 deg. corresponds to the twelfth harmonic and the ratio $\sqrt{150}$ to $\sqrt{51} = 12 \div 7$. In this way it is easy to calibrate an adjustable condenser very accurately. With the aid of the harmonics it is also possible to compare two capacities or self-inductances of greatly different size with a greater accuracy than is obtainable with a bridge. If, for instance, a condenser *A* (Fig. 3) is to be compared with another condenser *B* of about 60 times the capacity of the former, they are so connected to the transformer coil *S* that either *A* or *B* may be connected with *S*. The arc *K* is then so adjusted that its fundamental wave excites the system *SA* and the switch is then turned so as to connect *S* with *B* in circuit. The lever of the small adjustable condenser *C* (the calibration of which must be known) is now turned until the hot-wire instrument *H* again shows a deflection. As may be established by special wave measurements, this deflection is due to the eighth harmonic and $B + C = 64\,A$.—*Elek. Zeit.*, Aug. 27.

Galvanometer Scale for Thermoelement.—A. Zeleny.—It is often desirable to use a direct-reading instrument when employing thermo-electric couples for the measurement of tempera-

tures. An accurate scale for such an instrument can be constructed according to the formula

$$D'/D = (a + 2bt')/(a + 2bt).$$

The length of the division D' at any temperature t' is calculated from the chosen length of the division D at the temperature t. The increments required for the intermediate successive scale divisions are equal and their value is $(D' - D)/(t' - t)$. The scale is ruled preferably on a dividing engine. The first division is made of the chosen magnitude D, and each of the succeeding divisions is made larger than the one nearest preceding it by the amount of the above increment. The proper resistance required for the galvanometer circuit is found by placing the two junctions each into one of two vessels of different temperatures. When the circuit is open, the scale is set to indicate the temperature of the junction that is intended to be used as the known temperature junction, and when the circuit is closed, resistance is introduced into the circuit until the galvanometer reads the temperature of the other junction. This is the proper resistance for temperature measurements with that galvanometer, scale and couple. In any future measurements the scale is first set to indicate the temperature of the known temperature junction; then, when the circuit is closed, the temperature of the other junction is directly indicated by the galvanometer. A correct reading of the temperature is obtained regardless of what may be the temperature of the room or vessel containing the known temperature junction.—*Phys. Rev.*, August.

Measuring Capacity.—A. ZELENY AND A. P. ANDREWS.—A paper giving experimental results on the difference between the "free charge capacity" of paper condensers and telephone cables and the capacity value that is obtained by the ordinary method where the galvanometer remains in the circuit during the whole period of its throw. All of the curves determined show that after the free electricity is discharged, the liberated absorbed charge continues to flow at almost a uniform rate for a considerable time. The value of the capacity of paper condensers as obtained by the ordinary direct deflection method is larger than the true capacity value by an amount which in the condensers employed by the authors varies from 2 to 281 per cent, the amount depending on the condenser and on the period of the galvanometer. In a paper telephone-cable the increment was found to be 9.58 per cent when the quarter period of the galvanometer was 2.50 seconds. Since the condensers and telephone cables are employed with alternating currents where the effective capacity has approximately the free charge value, the ordinary method of measurement that is almost universally employed must be discarded even for commercial purposes. The value of the true free charge gives the measure of the "true" capacity of a condenser and should be employed in the calculation of the specific inductive capacity of dielectrics.—*Phys. Rev.*, August.

Magnet Steel.—G. HANNACK.—An article on the best steels for permanent magnets. Only iron alloys which can be hardened—that is, steels—can be used for permanent magnets. In general the coercive force increases with increasing hardness, but reaches a maximum at a certain degree of hardness and then decreases. According to Mme. Curie the limit of carbon content is 1.2 per cent. According to the author the content of carbon should be even less for tungsten steels. The chief elements in good magnets steels are carbon and tungsten. Silicon in small quantities is not detrimental. In a very good magnet steel of Boehler, the silicon is comparatively high, as shown by the following analysis: 0.597 per cent C; 5.369 W; 0.176 Mn; 0.018 P; 0.038 S; 0.255 Si; 0.004 Cu. Copper, nickel, and titanium are detrimental. The author succeeded in making very good magnets from chromium-vanadium steel without the use of any tungsten, but such magnets would be far too expensive. The composition of the steel, however, is not everything and the greatest care must be taken in the hardening process. The hardening temperature is, in general, near 850 deg. C. The ideal method of hardening seems to be in the use of an electric furnace with a fused electrolyte, but there are still some difficulties to be overcome in the use of the furnace. Large quantities of permanent magnets are used for telephones, meters, instruments, signal apparatus, etc.—*Stahl u. Eisen.*, Aug. 26.

Testing the Magnetic Properties of Iron.—G. KAPP.—An illustrated description of a new apparatus for magnetic tests of iron. It is in principle similar to that of Hopkinson. Two pieces of the steel are tested side by side in the form of two rods with conical ends, which are inserted in holes of the two end-pieces thereby closing the magnetic circuit. The two end-pieces are held together by means of a screw. The sources of error are claimed to be reduced to a minimum in this arrangement.—*Elek. Zeit.*, Aug. 27.

Selenium.—C. RIES.—An article on the effect of humidity on the electric properties of selenium. The electric resistance of selenium and its sensitiveness to light depend primarily on the method of heating and the humidity of the selenium and of the air, while all other factors are only of secondary importance. Humidity may have a very great influence. With respect to the heating process, care must be taken to heat continually without interruption to the proper temperature and for the proper length of time. The time of cooling and the atmosphere are also of great importance. It seems advisable to place the selenium in an evacuated tube. The paper contains considerable data on the temperature coefficient of the resistance of selenium, the electric resistance, the light sensibility of selenium and on the photo-e.m.f.—*Phys. Zeit.*, Sept. 1.

Meter.—A. KOENIGSWERTHER.—An English translation of his German paper on a new direct-current ampere-hour meter, which was recently abstracted in the Digest.—Lond. *Elec.*, Aug. 28.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—J. ZENNECK.—A theoretical discussion of the action of a partly horizontal antenna in sending electromagnetic waves in a certain direction. The explanation of the author is based essentially on the fact that the earth is a comparatively poor conductor.—*Phys. Zeit.*, Sept. 1.

Wireless Telegraphy—C. C. MONCKTON.—An illustrated article on the wireless telegraph system between the islands of Trinidad and Tobago. During the first two years the receiving was done solely with the Lodge-Muirhead steel-mercury coherer and recorder, but for the last six months other detectors and sound readings have been used in addition for practice.—Lond. *Elec. Eng'ing*, Aug. 20.

Wireless Telegraphy in a Certain Direction.—A. MONTEL.—An article giving a simple mathematical theory of the action of a partly horizontal antenna in directing wireless telegraph waves in a certain direction.—*La Lumière Elec.*, Aug. 22.

Thermoelectric Detectors.—C. TISSOT.—A reply to the criticisms of Branly. It is pointed out that tellurium detectors work without a battery, and are, therefore, not based upon a mere coherer effect. When they are connected with the antenna in parallel with a galvanometer, the galvanometer shows a deflection when waves impinge upon the system. The latter would hardly produce the unidirectional effect described if the detector simply operated by a variation of the closeness of the contact. Another characteristic difference is that the thermoelectric detectors respond, not in accordance with the amplitude of the variation of potential, but in accordance with the mean energy impinging upon the system. This may be proved by measuring the energy with a bolometer, an instrument by means of which detectors may be tested quantitatively. Good results are also obtained with other substances occupying extreme positions in the thermoelectric series, notably with fused sulphide of copper and its natural variety (chalcosine), as well as Becquerel's alloy, containing 10 parts bismuth and 1 antimony. The thermoelectric detector may be described as a "total-effect" instrument. It has properties which fit it in a special way for the receipt of signals in selective telegraphy and in wireless telephony.—*Comptes Rendus*, July 27; abstracted in Lond. *Elec. Eng'ing*, Aug. 13.

Miscellaneous.

Wave Detector.—A. G. ROSSI.—A description of a wave detector founded upon magnetostriction. Its mechanical working

utilizes Wiedemann's phenomenon of torsion by magnetostriction shown by a wire of magnetic metal when two magnetizations are superimposed in it, the one longitudinal, produced either by a coil coaxial with the wire or by a suitable system of magnets; the other circular and furnished by a current which traverses the wire itself.—Lond. *Elec.*, Aug. 7.

Hard Wood.—An anonymous article recommending the more extended use of hard woods for constructional purposes. It is argued that for flooring, and even for founda ions for certain classes of machinery in generating stations, they are particularly suitable, and the suggestion is made that on account of their comparatively non-inflammable nature they might in some cases use slate for switchboards.—Lond. *Elec. Eng'ing*, July 30.

Marseilles Exposition.—A description of various exhibits at the present exposition in Marseilles. Various measuring instruments of Jules Ricards and cable exhibits of the Berthoud-Borel Company are described.—*L'Ind. Elec.*, August 10.

Management of Work Shops.—E. Thomas.—A paper on the management of engineering work shops. The author gives some impressions received from a number of visits paid to engineering works engaged in widely different manufactures, and draws attention to the many economies that may be obtained owing to the variety of ways in which waste of time and material come about.—Lond. *Elec.*, August 7.

NEW APPARATUS AND APPLIANCES

Electrical Works Postoffice at Ampere, N. J.

In order to facilitate handling the increasing volume of mail at the Ampere, N. J., postoffice, the Crocker-Wheeler Company has built a brick and cement postoffice building on its grounds. The architecture is of a modern Grecian style, which might be termed "federal." Upon the pediment above the main entrance is an eagle and United States shield in high relief. The interior of the building is finished in quartered oak and the floor is of mosaic tile. Upon the walls hang a facsimile of the Declaration of Independence, with the coats of arms of the various States, a Constitution of the United States and an autograph letter and portrait of André Marie Ampere (1775-1836), the great savant, after whom the town of Ampere is named. The new postoffice will still further beautify the grounds of the Crocker-Wheeler Company.

POSTOFFICE AT AMPERE, N. J.

Direct-Current Motors for Driving Centrifugal Fans.

The direct-current motor shown in the accompanying illustrations has been designed particularly for driving centrifugal fans. The magnet frame, which is of cast iron, is machined for the pole-pieces, which are built up of soft steel punchings, riveted together between end-plates while under pressure. The punchings are so formed as to provide a support for the field-coil and to so distribute the magnetic flux as to produce sparkless commutation under wide variations of load. The pole-pieces are bolted to the frame by hexagon-head tap bolts, which pass through the frame and are threaded directly into the pole-piece. By removing these bolts a pole-piece with its field-coil may be removed without disturbing the armature or dismantling the motor. The field-coils are machine wound of double-cotton covered copper wire, insulated and held together by two layers of heavy tape.

The armature is of the iron-clad slotted-drum type, built up of laminations assembled on a cast-iron sleeve, which is provided with openings for free circulation of air and has an extended hub for the reception of the commutator shell, making the armature and commutator one self-contained member. The brush holders are supported by a ring of spider construction, which is, in turn, supported in a machined recess in the magnet frame, being clamped into position by the front bearing bracket. The brush rigging is thus firmly held in position, and, while it may be easily shifted, there is small liability of the brushes being thrown out of position or tilted, each brush being provided with a braided copper cable shunt or pig-tail, thus relieving the brush holder body and springs from carrying any current.

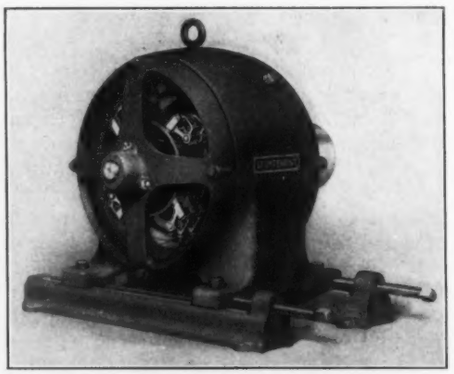


FIG. 1.—GENERAL VIEW OF MOTOR.

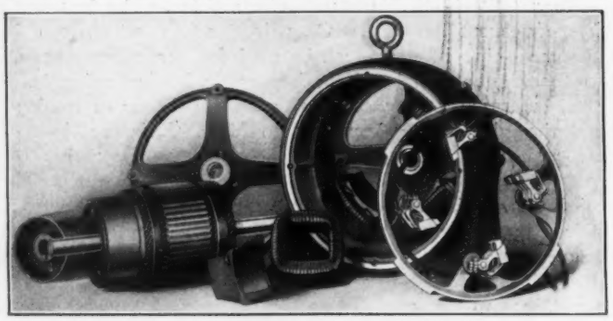


FIG. 2.—DETAILS OF MOTOR.

This motor has been developed by the B. F. Sturtevant Company, Hyde Park, Mass., for use with its steel-plate centrifugal fans.

Cable Hauling on the New Manhattan Bridge.

The four huge cables that will support the new Manhattan Bridge, connecting the Boroughs of Brooklyn and Manhattan, are now being hauled into place. Each cable will contain 37 strands of 256 wires each, a total of 9472 wires in each cable, which must be strung wire by wire. The enormous amount of work involved will be done by machinery driven by Crocker-Wheeler electric motors.

The stringing of the wires in each cable is accomplished by means of two traveling sheaves carried on opposite legs of an endless steel rope. Each sheave consists of a 3-ft. grooved wheel fastened to the hauling rope by means of wrought-iron brackets. The hauling rope is ¾ in. in diameter and runs above the position of the bridge cables on heavy rollers supported on uprights on the temporary foot bridge. There are five of these hauling rope supports on the center span, two on each end span and one on each tower.

The hauling sheaves move back and forth across the bridge from anchorage to anchorage, a distance of 3223 ft. They are attached one to each leg of the hauling rope so that they move in opposite directions, one crossing the bridge as the other returns.

The wire is delivered to the bridge on enormous reels or spools, each of which weighs three tons. Half of these reels are placed at each end of the bridge. The end of the wire from a reel at each end of the bridge is put over the hauling sheave at that end and fastened to the anchorage. The machinery is then started and the sheaves move across the bridge, unwinding one wire from each reel. Two wires are thus strung by each sheave every time it crosses the bridge. When the sheave reaches the opposite side of the bridge the bight of the wire is taken off and made fast to that anchorage, and a new wire hauled from that side on the return trip.

The wires are laid in temporary saddles of four grooved pulleys at each anchorage. As the hauling of each strand of 256 wires is completed the wires are bound together at intervals, and the strand is lifted from the temporary saddle by means of a chain hoist and laid in its proper place in the permanent saddle. Two strands of each cable are wound simultaneously by the two sheaves of each hauling rope.

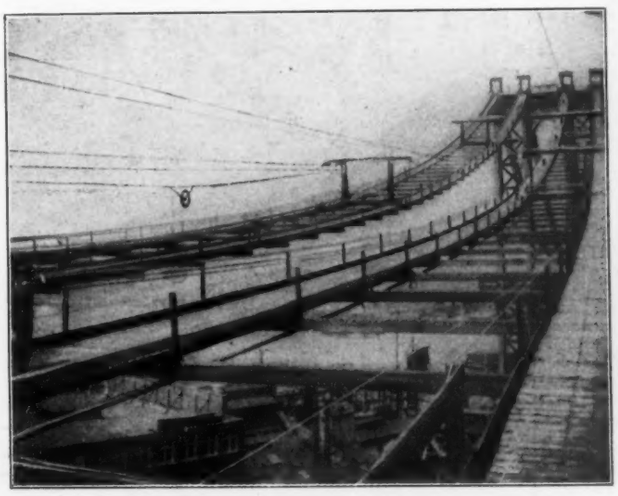


FIG. 1.—VIEW OF CABLES FROM ANCHORAGE.

There is a separate hauling mechanism for each of the four bridge cables, so that they are strung independently of each other. Delays are therefore not cumulative. The delays in one cable affect that cable alone, and the work proceeds on the others. This results in a very considerable saving of time.

Each hauling rope is driven by a 50-hp, 220-volt Crocker-Wheeler motor of the type designed for rolling mill duty, being well adapted to work of this kind where sudden overloads and frequent starting and stopping are encountered. The motors are fully enclosed and capable of withstanding all kinds of weather and rough handling. Each motor is geared to a countershaft at a ratio of 5 to 1, and the countershaft is bevel geared to the driving shaft at a 5-to-1 ratio. On the driving shaft, above the gears, is a wood-lined, grooved, 6-ft. traction wheel, which drives the hauling rope. A 5-ft. idler wheel is also provided so that the hauling rope passes the traction wheel twice in order to produce the necessary grip.

The hauling rope moves at a speed of approximately 480 ft. per minute. It carries the sheaves across the river in from 7 to 8 minutes. Allowing for the time used in attaching wires at each end, about three trips are made per hour. It is estimated that at this rate the work of hauling will occupy four months, some time being consumed in fixing guide wires for each strand and in adjusting the wires after they are hauled.

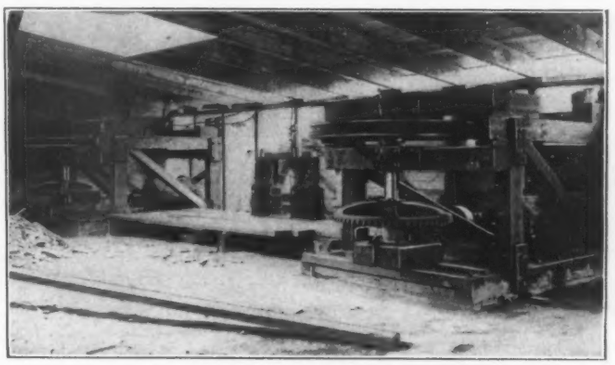


FIG. 2.—VIEW OF DRIVING MECHANISM.

All of the driving motors are located on the anchorage at the Brooklyn end of the bridge. The wire was delivered by John A. Roebling's Sons Company, the company that delivered the wire for the old Brooklyn Bridge 30 years ago. The work of building the cables is being carried on by the Glyndon Contracting Company, of 2 Rector Street, New York City.

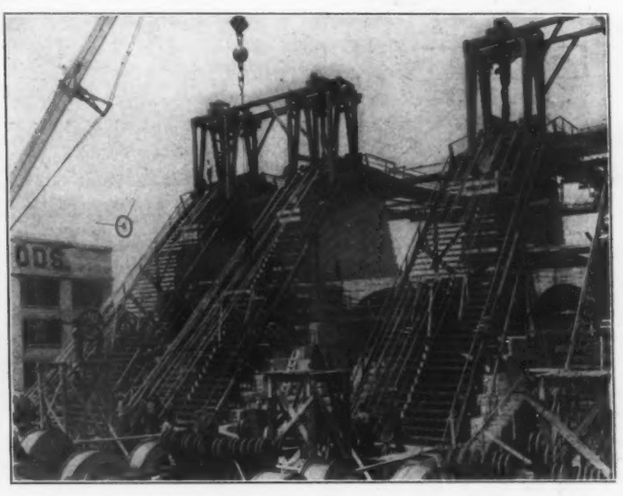


FIG. 3.—ANCHORAGE, ONE HAULING SHEAVE STARTING ACROSS.

The hauling equipment for this bridge differs from any previously used. It will be remembered that in hauling the cables for the Williamsburg Bridge use was made of two steam engines connected to the same driving shaft. It later became necessary to divide the shaft and use the engines independently to avoid cumulation of delays. Even with that arrangement only two cables could be hauled simultaneously. The Glyndon Company's plant has double the working capacity besides being electrically instead of steam driven, with the consequent ease of manipulation and control.

Manhole Transformers.

The accompanying illustration relates to transformers built by the Westinghouse Electric & Manufacturing Company for use in underground distribution. The transformers are installed in subway manholes, which are liable to flooding from heavy rains or overflow water; moreover, the underground chambers are rarely well ventilated. For these reasons it is necessary to enclose the transformer in a hermetically-sealed case, and design it for an exceedingly low temperature rise. The transformers are of the oil-insulated type, and a large air space is left at the top of the case to take care of any expansion of the oil under a rising temperature. Necessarily, this action compresses the air in the upper portion of the case and causes

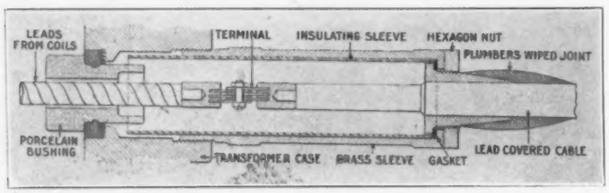


FIG. 1.—BUSHING FOR MANHOLE TRANSFORMER LEAD.

a slight rise in pressure. Under abnormal operating conditions, such as a short-circuit, a considerable rise in this pressure may occur, and the transformer case may be seriously injured. In order to avoid any danger from such occurrences a horn-shaped brass casting is used for the oil plug in the cover. The mouth of the horn is closed by a thin sheet of copper which will rupture, acting as a safety or relief valve for any excess pressures. Each case is tested with an air pressure of about 10 lb. per square inch and carefully inspected for leakage before shipment.

For the leads of these transformers use is made of an improved bushing which permits it to be connected to or disconnected from the line without removing the cover or otherwise opening the transformer case. This design of bushing eliminates any necessity for breaking the joints of the transformer case and removes the danger of water leaking into the transformer through a joint made under difficulties in the confined space available in a manhole. A further advantage of this joint, which is shown in Fig. 1, is that it permits transformers of the next larger or smaller size to be substituted in any manhole. Three sizes of bushings cover the full line. The joint is made without any solder except that in the plumber's wiped-joint required to connect the lead covering of the cable to the brass sleeve. This is a permanent connection and made when the first transformer is installed.

A number of transformers of this design have been arranged to operate on a three-wire low-tension circuit with a grounded neutral. When this method of operation is used, the neutral tap on the low-tension side of the transformer is grounded directly on the transformer case through a stud terminal. The high-tension side of the single-phase transformer is provided with only two outlet bushings.

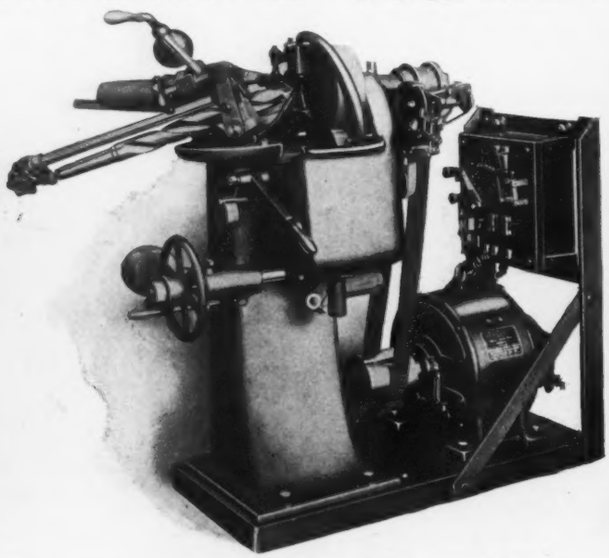
Motor-Driven Drill Grinder.

The drill-grinding machine illustrated herewith is equipped with a 2-hp, direct-current motor, the entire outfit being self-contained. The grinder is suitable for any type of double-tip drills, varying from 5/16 in. to 3 in. in diameter. The grinding of the tips is done on the face of the stone, or grinding wheel, which insures a correct surface, as the drill is moved over the entire face of the wheel. By a special device the correct pointing of the drill is secured. An interesting feature is the means adopted for providing an ample supply of water at the grinding surface. The wheel proper is protected by a cover at all points except where the drill comes in contact with it. On the cover there is an adjustable nozzle through which water is delivered in an abundant flow to both drill and wheel without splash or waste. The water is moved by a small centrifugal pump driven from the main motor. The grinder is manufactured by William Sellers & Company; the motor is a standard Westinghouse machine.

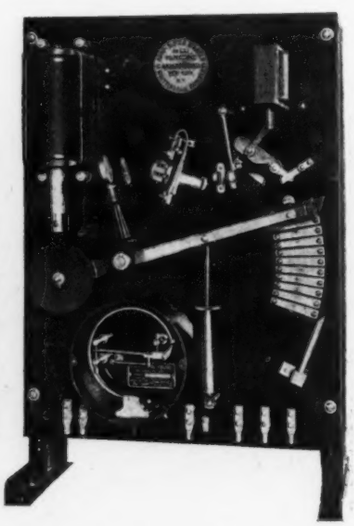
Controller for Electrically-Driven Hydraulic Elevator.

The accompanying illustration shows a gravity solenoid starter and pilot pressure regulator forming part of a hydraulic elevator equipment installed in a modern office building. The pumping plant consists of a rotary pump, direct-connected to an electric motor. The controller is interesting in that the magnet which operates the main line switch lifts the weight which is used to return the resistor arm to its starting position and thus permits the arm to fall by gravity at a speed dependent upon the consistency of the oil in the dash pot, as soon as the switch closes. A bourdon tube is used in the pilot pressure-regulating switch to close one of the other of two contacts on a small Darrin magnet relay switch shown directly above the resistor segments. The relay, switch-magnet breaks its own circuit in operating, thus preventing arcing on the small contacts of the pilot, pressure-regulating switch. Equipments of this type are installed where space is limited. The controller is built by the Automatic Switch Company, of New York.

FIG. 2.—MANHOLE TRANSFORMER.



MOTOR-DRIVEN DRILL GRINDER.



CONTROLLER FOR ELEVATOR PUMP MOTOR.

Double-Joint Lamp Fixture.

McLeod, Ward & Company, of New York City, are marketing a line of double joint fixtures suitable for office or household use. Fig. 1 shows one of these fixtures which is intended as a reading lamp for bedroom use. The bracket may be at-

FIG. 1.—DOUBLE-JOINT LAMP FIXTURE.

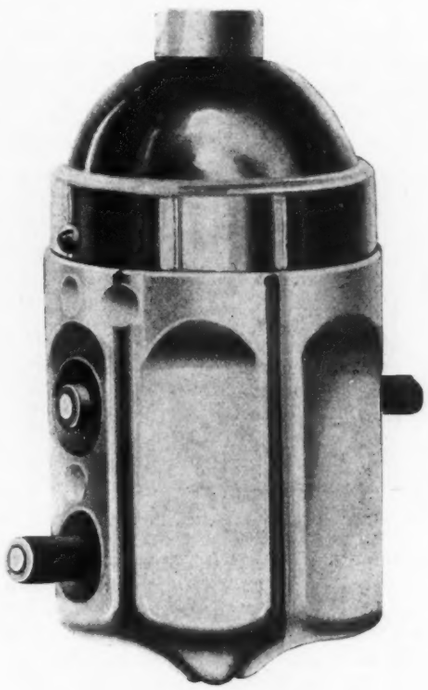
tached to the head of a metal bedstead or to a vertical or horizontal rod and the light directed where desired. The details of the double joint are clearly shown in Fig. 2. From this it is evident that by means of the double hinge arrangement, the lamp can be adjusted in either a horizontal or vertical plane.

FIG. 2.—DETAILS OF DOUBLE JOINT.

The fixture is made in a variety of styles to meet different conditions. The portable fixture intended for use with typewriters is equipped with two brackets and lamps, while the desk, bracket, bookkeeper, portable and combination fixtures are equipped with only one lamp; the double joint is, of course, used on all.

Two-Circuit Pendant Switch.

A compact two-circuit pendant switch is illustrated herewith. The body of the switch is of porcelain, the switching devices consisting of two three-piece mechanisms for separately controlling two circuits. The switch may be used with double-



TWO-CIRCUIT PENDANT SWITCH.

circuit lamp clusters, with two separate lamp circuits or one button may control a lamp circuit and the other a fan. This switch has just been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Cigar Lighters for Continuous and Intermittent Service.

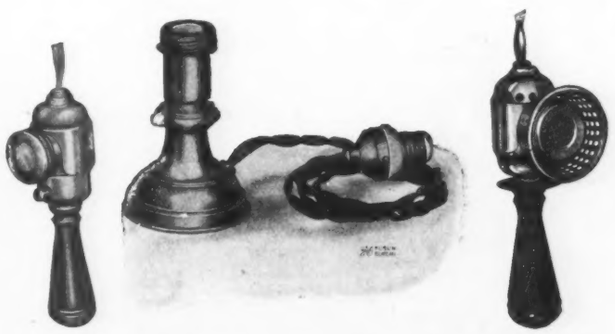
Cigar lighters for both continuous and intermittent service are now being manufactured by the General Electric Company in pendant desk and table types. These cigar lighters are suitable for operation on either alternating- or direct-current circuits and may be readily connected to any ordinary lamp socket.

For intermittent service both the pendant and table types are available, but the pendant type only is suitable for continuous operation. Those for intermittent service are equipped with a push button for closing the circuit during the period of operation, which is generally from four to six seconds. The continuous-service lighters are nominally left in circuit, but have a snap switch for turning the current off when not in use.

The heating unit is somewhat similar in appearance to the ordinary fuse plug, and for intermittent service consists of several lengths of coiled wire lightly cemented to a thin sheet of insulating compound. The ends of the wire are connected to terminal screws in the porcelain plug base, which is screwed into a socket in the body of the lighter. A thin piece of perforated mica placed in a metal cap fitted to the porcelain plug base protects the heating coils. To light the cigar or cigarette it is only necessary to place the end against the perforated disk, the hot air, drawn through the holes in the mica, igniting the cigar even before the mica disk becomes red.

The intermittent desk type, as shown in the illustration, is compact and simple in design, the heating element being similar to that used in the intermittent pendant type.

The construction of the plug for continuous service is simi-



FIGS. 1, 2, AND 3.—CIGAR LIGHTERS.

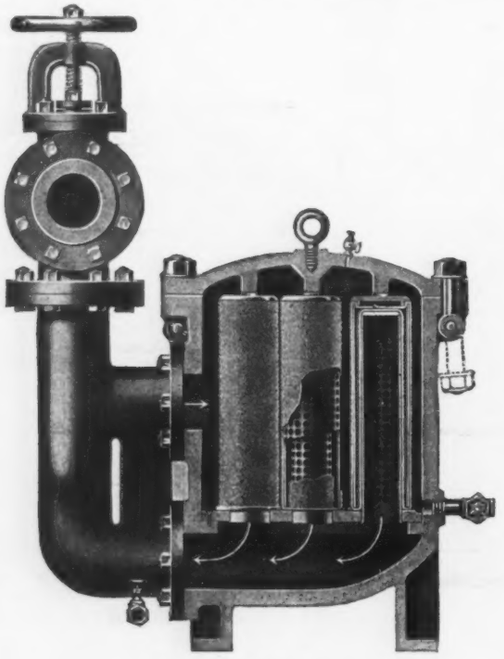
lar to that for intermittent service, except that the coils of wire are completely filled with cement between turns. With this unit no mica covering is used as a perforated insulating compound placed on the top of the heating unit conducts the heat to the cigar. As will be noted in the illustration, these plugs are surrounded by a perforated metal mouthpiece which protects the plug and also prevents the liability of anyone being burned by coming in direct contact with the heating element. In this type of cigar lighter, the heating plug cannot be removed without the use of a special spanner. This feature is of special importance when the lighters are used in public places, such as hotels, cigar stores, etc.

These cigar lighters are made for voltages from 95 to 125 volts. The power consumption is very low, being 75 watts for the intermittent type and 25 watts for the continuous type. The cost of operation and the life has been determined after a series of careful tests. It was found that with the intermittent type 1000 lights could be obtained at an approximate cost of 1 cent where power is sold for 10 cents per kw-hour. The continuous-service lighter can be operated at a cost of about 3 cents per day. The durability tests show that the intermittent type will give about 22,000 lights before deterioration of the heating element occurs. Tests now being conducted on the continuous-service types show a maximum of over 5000 hours at the present time. These tests are still in progress so that this value will be exceeded.

Feed-Water Filter.

The accompanying illustration shows the Blackburn-Smith feed water filter and grease extractor, a device which is installed in the feed line and subjects all entering water to double filtration through separate terry cloths. Referring to the engraving, water from the feed pump enters the inlet, passes into the upper or filtering chamber through the filtering cartridges, into the pump chamber, and thence from the outlet to the closed heater or boiler. The water passes through the cartridges with little friction, but in the course of time, as the foreign matter accumulates on the filtering material, some resistance will result. This resistance is shown by the pressure gages with which the filtering and outlet chambers are equipped. A water relief valve automatically prevents the building of excessive pressure in the pump discharge line, and an air cock located near the center of the cover permits the accumulation of air in the filter to escape.

The valve chamber is made right-hand or left-hand as desired, so that the filter may be set on either side of the line. Both the main valves are in a straight line with the feed pipe. The filter is put into operation by turning the hand wheels on both inlet and outlet valves to their upper limits. When these two wheels are turned to their lower limits the feed water goes straight past the filter. The by-pass and main valves are wholly within the feed line and the filter body and valve chamber may be disconnected close to the valves. It is thus possible to remove almost the whole filter without shutting down the plant. The number of cartridges in each filter varies with the size of the unit. Each cartridge consists of two concentric cylinders of heavy perforated brass tubing covered with linen terry. The lower end of the inner cylinder is expanded



FEED-WATER FILTER.

into the partition which separates the filtering and outlet chambers, and the upper end is covered by a perforated brass cap. The filtering media conform to the shape of the cartridges, the closed end being drawn down to a nice fit over the inner cylinder, reversed over the outer cylinder, and the other end tucked in and clamped by the brass cap. The small size of the cartridges permits the media to be changed quickly and easily when foul. Heavy impurities which may at times cling to the walls of the filtering chamber or settle to the bottom may be blown out by opening the sludge valve and admitting live steam through a tap for that purpose. The body and valve chamber of the filter are ordinarily made of cast iron and each filter is tested to a hydrostatic pressure of 300 lb. to the square inch. The filter is made by James Beggs & Company, 109 Liberty Street, New York.

Boiler-Tube Cleaner.

Steam or compressed air will effect a considerable saving in cleaning the scale from the tubes of water-tube boilers where water is scarce and is even more convenient than water power. Besides, cleaning may be accomplished with less mess in the boiler room. The new Weinland steam and air boiler tube cleaner, shown in Figs. 1 and 2, consists of a jointed steel shaft with a powerful cleaning head on one end and a rotary engine on the other. The only other fixtures are a support-

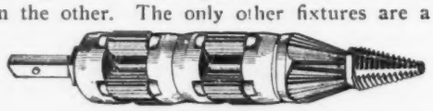


FIG. 1.—BOILER-TUBE CLEANER.

ing trolley consisting of a rope-operated differential pulley block and an overhead pipe on which it rolls across the boiler front to align to each vertical row of tubes. The self-locking rope differential between the motor and the overhead pipe offers adjustment of the motor to proper height for any row of tubes or to keep the shaft concentric with the tube axis as the head proceeds down the tube. None of the weight of the motor is supported by the operator. The two handles are merely for guiding the machine and pushing it against the scale.

The operation of the driving device, steam at proper pressure or compressed air, enters through a hose connected on the rear side of the case, and operates against three radial paddles or pistons, thus compelling the motor to revolve at a speed determined by the pressure of the steam and the forward thrust against the scale. The pistons are forced outward to a steam-tight fit with the case by the admission of pressure at the back end of the cages in which they slide. The admission ports (three holes near the handles) admit steam to the space between the rotor and case. Each piston is under full steam pressure until the rotor has made a quarter turn; and as there are three pistons, the rotative effort is practically continuous.

The important bearing surfaces and cage in which the pistons slide are made from hard bronze and wear is further minimized by lubricators on both the front and rear of the case, which force the lubricants to these bearing surfaces.

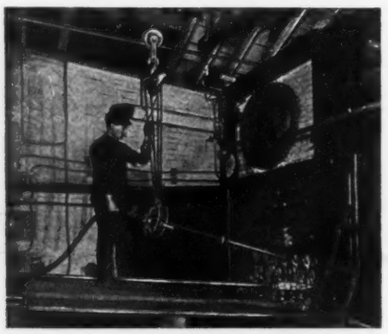


FIG. 2.—CLEANER IN USE.

From 5- to 9-hp may be brought to bear upon the scale from this machine, and by throttling the steam the torque of the shaft and the speed of the cutting head may be adapted to any hardness or thickness of scale. At slow speeds and under heavy torque, it is stated that the cleaner head will not become stalled in the worst scale. When used with compressed air, the motor can exhaust direct to atmosphere, but with steam a short length of hose is attached to conduct the exhaust out of the operator's way. This machine saves power as well as labor when steam is used, as there are no losses due to the operation of pumps or compressors. It is made by the Lagonda Manufacturing Company, of Springfield, Ohio.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The expected expansion in the jobbing trade and the development in industrial activity come so slowly that many more or less impatient business men are inclined to become uneasy. That there is some betterment all admit, but that it will be slow in increasing is natural. The notable enlargement in the movement of spring wheat and other cereals and cotton to market has done something toward helping business and much in improving collections. Retail trade is better in the West and South and the railroads are moving many more cars. The agricultural sections have done much better than the industrial centers because the prices of farm products remain high and crops are plentiful, while there are still idle workmen in every factory city. As far as the crops are concerned there is little change in the situation. The wheat, oats and other small grain crops, while not up to the high promises of the first part of the season, are for the most part above the aggregate yields of last year. The corn crop, it is assured, will be greater than in 1907, although in some of the States of the Central West continued dry weather has caused deterioration. In Nebraska, the Dakotas, Iowa and some portions of Kansas corn is yet 30 days from maturity, and in that time, of course, changes may take place. Dry weather has also done something to retard the development of cotton in certain sections of the South. The bolls are opening too rapidly and there is some complaint of shedding. In Texas, Louisiana and in the Southern sections of other States, picking and marketing are active and the gin reports are unusually high for this season of the year. The rice and sugar crops of Louisiana are good. In Delaware and Maryland the tomato pack promises to be only about half of that of last season. Drought in the early summer, followed by copious rains in the latter part of July and in August, caused considerable rotting among the plants, and prices in Baltimore at present are almost double those of a year ago. While there was considerable revival in the building trade in July, August did not compare so well with last year, and for the eight months of 1908, the decrease from the same period of 1907 is about 25 per cent. The lumber business, especially in the South and the Pacific Northwest, has shown considerable activity, many mills having resumed at full capacity. In coal mining there is some improvement and in pig iron the output is increasing although prices are inclined to be weak and there are reports of concessions to large consumers. The production of pig iron for August was heavier than for any other month since last November. In the textile trades the slight improvement is due to the extreme conservatism which fall buyers have exhibited. In the meantime the railroads are doing better in gross earnings than at any other time for a year and as money has moved to the agricultural sections in good volume for the purpose of bringing the crops to market the carriers expect further improvement in traffic. The demand for money has improved, and interest rates, while still abnormally cheap, are a trifle stronger. Business failures for the week ending Sept. 10 number 191, against 210 in the previous week, 172 in the corresponding week of 1907, 164 in 1906, 188 in 1905 and 167 in 1904. The report for the week under review shows the smallest number of failures of any week since last October.

THE COPPER MARKET.

There has been very little activity in the copper market during the past week. Exports have been lighter than during any other week since June 1, imports have been heavier than usual, the demand for consumption here and abroad has been light and there has been rather more pressure to sell by both producers and middlemen. In spite of these conditions the quoted price of the metal has remained the same and, while it is reported that small lots have been disposed of at concessions of ⅛ to ¼ cent, there is no record of sales of large amounts of copper in such terms. One significant feature in the market is that the Amalgamated company has reduced its London selling price £1 per ton. The principal producers and selling agencies insist that the demand for copper is much stronger and that the actual sales are much more numerous than the information given to the public would indicate. The claim is made by some authorities that the demand is practically equal to the present production and that stocks are accumulating very slowly. The statistical position of copper, according to sources of information heretofore accepted as authentic, shows large over production and enormous surplus stocks, especially in Europe. The electrical manufacturing concerns are not so busy that they would be buying heavily unless they were purchasing against possible future orders, a course which seems hardly probable in view of the accepted copper statistics. The American copper production for August was 99,048,700 lb. and the total for the first eight months of the year was 659,094,984 lb. This is a larger total production than for August in 1907, but the total for the eight months of this year is 96,727,256 lb. less than the figure for the corresponding period of 1907. The European speculators seem to have become tired of accumulating copper and in fact show a disposition to get rid of some of their holdings. Exports from Atlantic ports from Sept. 1 to Sept. 14 have been 8,533 tons, more than half of this amount being on the latter date named. Imports during the month have amounted to 2334 tons of refined, 100 tons of matte and 4300 tons of ore. Prices quoted on the Metal Exchange Sept. 14 were:

Lake	13⅝ @ 13¾
Electrolytic	13⅝ @ 13¾
Castings	13⅛ @ 13¼

The London market was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	61	0	0	60	17	6
Standard copper, futures	61	15	0	61	12	6
Market	Steady			Quiet.		
Sales of spot	400 tons					
Sales of futures	800 tons					

Extreme fluctuations for the year:

	Highest	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 5 0
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	60 0 0

HUDSON TUNNELS NEAR COMPLETION.—Mr. William G. McAdoo, president of the Hudson & Manhattan Railroad, has made the following statement with regard to the completion of the tunnels between Jersey City and New York: "The tunnels between the Pennsylvania Station in Jersey City and the Hudson Terminal in New York lack only about 1,200 ft. of completion. This gap is between the pier head line and Washington Street, on the New York side. Work on the tunnels under Cortlandt and Fulton Streets is carried on night and day. The caissons in Fulton and Cortlandt Streets, adjoining the Terminal Buildings, and forming the approaches from the tunnels to the station underneath the Terminal Buildings, are 90 per cent completed. This work is prosecuted night and day, and should be completed and the street surface restored within the next 90 days. More rapid progress is now being made on these approaches, and on the tunnels under Cortlandt and Fulton Streets, than at any other time since the work was begun. On the Jersey side we are on the last stages of work at the terminal station underneath the Pennsylvania Railroad station in Jersey City." Mr. McAdoo expects all of the lines to be in operation early in 1909.

HOUGHTON COUNTY TRACTION COMPANY.—Stone & Webster have organized the Houghton County (Mich.) Traction Company to take over the property assets and franchises of the Houghton County Street Railway, which the firms controls. The company operates through the copper mining sections of the Lake Superior region and the present plan includes the raising of new funds for the extension and improvement of the system. The growth of population of the Lake Superior copper region is shown by the business of the Houghton County Street Railway, which has increased in gross receipts from $105,000 in 1901 to $250,000 in 1907. The Houghton County Traction Company will have an authorized issue of $1,600,000 first mortgage consolidated 5 per cent bonds, $750,000 of which

will be reserved to retire a like amount of Houghton County Street Railway 5 per cent first mortgage bonds, $400,000 will be sold at once to cancel the floating debt, and provide money for extension of the line to Mohawk, and the remaining $450,000 will be held for future additions.

TOKIO HYDRO-ELECTRIC PROJECT.—A large hydro-electric transmission scheme, including duplicate lines, each 100 miles in length, is rapidly nearing the construction stage in Japan. This is an Anglo-Japanese enterprise in which J. G. White & Company, New York, and Dick, Kerr & Company, Limited, London, England, are interested. Both of these firms are taking part in the preliminary engineering work and in the financing of the project, which includes immediate development by waterfalls of 60,000 hp, the energy to be transmitted to Yokohama and Tokio, more than 100 miles distant. Mr. J. M. Howells, an American engineer representing an English syndicate, together with Japanese electrical engineers, have made most thorough investigations of the scheme, and their preliminary plans have been confirmed by a final survey made by Messrs. J. D. Schuyler and C. S. Crane, American engineers, and Messrs. R. Rutherford, Charles S. Schultz, W. Burton and M. Walker, English engineers. The station site is capable of an ultimate development of 150,000 hp. A head of 3000 ft. is available. An extensive market for the energy will be found in Tokio, which has a population of about 2,000,000, and in Yokohama, 30 miles distant, a thriving seaport. Each of these cities has an electric railway system.

HELP WANTED ADVERTISEMENTS.—An advertisement was inserted recently in our pages for some one to take charge of a lighting plant at a reasonable salary. We have received an inquiry from a reader in Chicago, who answered this advertisement, but was a little resentful because his answer was not acknowledged in any way. On looking up the matter we find that the advertiser has already received so many answers that he requested us to forward him no more, as he could not attend to them. We are, of course, forwarding to him whatever replies are received, but the circumstances will readily explain why one applicant for the position might be disappointed, for various reasons altogether unconnected with his merit or availability. Advertisers have sometimes complained to us that many of the applicants for positions are utterly unqualified to do the work which they seek to secure, and, in spite of that fact, are extravagant in their ideas of the value of their services. With a business developing so rapidly as that of the electric light and power industry, it is safe to say that no person of ability and industry goes long without finding a position, giving him a fair salary with prospect of advancement; and the "help wanted" advertisements often furnish just such opportunities.

NO MEETING OF THE WESTINGHOUSE COMMITTEE.—No meeting has been called yet by the Westinghouse Readjustment Committee to hear the reports of the various committees seeking subscriptions under the merchandise creditors' plan of reorganization. The time limit for these subscriptions expired Sept. 1, but as a majority of the members of the Readjustment Committee were out of town at that time no meeting could be held. Mr. Adrian H. Larkin, of the counsel to the committee, states that it is probable no meeting will be held before next week and that no date has been decided upon. It is understood that since the last report of the Soliciting Committees, dated June 22, subscriptions have been received in small numbers. Aside from the agreement of several bank creditors to accept the plan and take stock, little progesss has been made. It is believed that further time will be requested and allowed, and absolute confidence is expressed by the members of the various committees in the final success of the plan.

GROWTH OF WIRELESS SERVICE.—The United Wireless Telegraph Company is rapidly perfecting its service on steamships and along the Pacific Coast. It has increased the number of its stations 50 per cent within the past four months and is now able to take commercial messages all along its line. A station has recently been established at Katella, Alaska. A mast has been erected at Cordova and the station at that point will be in operation in a short time. A 20-kw station has recently been opened at San Domingo City. This station will improve the connection between the West Indies and the Central and South American countries. The factories of the company have been kept busy, but new machinery has been added and additional help employed until the management believes that it has caught up with its orders.

ELECTRICAL EXPORTS.—Electrical exports continue to show a serious decline, and as each month goes by the rally seems more distant. For the month of July the export of heavy electrical machinery was $523,355, as compared with $886,057 a year ago. In electrical instruments, telegraphs and telephones the falling off is equally marked, the amount for last July being only $429,080, as compared with $694,938. The total is only $952,435, while for the corresponding month in 1907 it was $1,580,995. The decline is almost universal, but it is interesting just at this juncture to note that British Australasia increased its orders slightly. The demand for electrical machinery from the United Kingdom fell off from $150,016 to $45,215, and about the same decline in electrical instruments may be noted with regard to Brazil.

STORAGE BATTERY ORDER.—The Electric Storage Battery Company, of Philadelphia, Pa., has recently closed a contract with the Chicago City Railway Company to furnish and install in the Plymouth Court substation a storage battery, complete with booster, switchboard and wiring, rated at 4800 amp for one hour, it being permissible to discharge the battery at rates up to 9600 amp in emergency service. The battery is to be operated on a 550-volt bus. It will be charged at times of light load and discharged as occasion may require on the peak loads. Its location will be adjacent to the "Loop District" of Chicago, which will make the battery of value as a reserve in the event of any derangement of the substation, high-transmission lines or power station.

HUDSON RIVER ELECTRIC POWER COMPANY BONDHOLDERS.—At the request of a majority of the bondholders, under a call issued some weeks ago, a protective committee has been organized which will make an examination into the condition of the company. The chairman of the committee is James R. Hooper, actuary of the New England Trust Company, of Boston. Other members of the committee are Gordon Abbot, president of the Old Colony Trust Company, Boston; Horace E. Andrews, president of the Mohawk Valley Company; John P. Reynolds, Jr., John S. Scully, formerly president of the Diamond National Bank, of Pittsburg, and Edwin S. Webster, of Stone & Webster.

MARCONI TO DEVELOP HIS SERVICE.—Mr. William Marconi, who has just arrived in this country, announces that he will erect a new station at Cape Cod, Mass., and will lease a land line from that place to New York City. Before going to Cape Cod, Mr. Marconi announced his intention of visiting Cape Breton to perfect the service from that point to Europe. "When this has been done," he said, "we shall generalize the Atlantic service and be in a position to carry all kinds of press and commercial messages. After this we shall turn our attention to service on the Pacific."

PHILADELPHIA RAPID TRANSIT FULLY PAID.—Sept. 8 was the final day of payment on the last instalment of the Philadelphia Rapid Transit Company's stock. There is now about $30,000,000 capital stock, or 600,000 shares at $50 per share paid in. There have been nine separate assessments, beginning with the first in 1902 upon organization of the company. The first seven instalments were for $5 a share each, and came from about 6 to 12 months apart. The last two instalments were for $7.50 each, the first payable Sept. 9, 1907, and the last Sept. 8, 1908.

MONTREAL LIGHT, HEAT & POWER COMPANY.—The story is again revived that Mr. Leslie M. Shaw, formerly Secretary of the Treasury, is heading a syndicate which is endeavoring to purchase control of the Montreal Light, Heat & Power Company. The present offer is said to be in the shape of a 99-year lease, the syndicate to reserve the right to purchase the stock at 110. Interests connected with the Montreal company in New York, while not admitting that such an offer has been made, say that if made it would not be accepted.

LARGE ORDER FOR METERS.—The Westinghouse Electric & Manufacturing Company has just been awarded what is said to be the largest single electric meter contract ever been made since electricity has become a manufacturing industry. This contract calls for $75,000 of polyphase wattmeters, and came from the Rio de Janeiro Tramway, Light & Power Company, of Rio de Janeiro, Brazil.

TO BUILD NEW JERSEY TRACTION LINE.—A company has just been incorporated in New Jersey under the title of North Jersey Rapid Transit Company for the purpose of constructing a railroad from Paterson, J. J., to Suffern, N. Y. The capital stock is to be $1,000,000.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market during the past week has had another of its intermittent reactionary turns. There was some pressure to sell and the net changes, although generally losses, were unimportant in most cases. The Harriman issues, Reading and a few other stocks advanced. The relapse caused neither anxiety nor wonder and it has in no way lessened the general confidence felt by all close observers that prices have been pegged to stay and that they are likely to go still higher. Whether it is the Harriman interest, or the Rockefeller interest or Morgan and his friends or some other less prominent group that is controlling the advance movement, abundant confidence seems to be felt in its strength and in the ability of the operators to prevent any serious backward slip. The news developments in the market last week might, under other conditions, have affected sentiment if not actual trading materially. More encouraging crop figures were made public by the government. Announcement was made that the output of pig iron in August was the heaviest of any month since last November, the much-criticised "commodities clause" of the Hepburn law was declared to be unconstitutional in the United States Circuit Court, and the decrease in idle cars on the railroads was very

NEW YORK.

	Sept.4	Sept.14	Shares Sold		Sept.4	Sept.14	Shares Sold
All.-Ch.	11½	11	500	Int.-Met., pfd..	32⅞	33½*	4,297
All.-Ch. pfd....	35	34	900	Mackay Cos. ..	69	69¼	1,100
Amal. Cop.....	79⅛	78¼	86,900	MackayCos.,pfd.	68	70	——
Am. D. T.....	39*	35*	——	Manhattan Elev.	137	139*	300
Am. Loc.....	54	46¼	154,430	Met. St. Ry....	34½*	30*	50
Am. Loc. pfd..	105½	102¾	1,600	N.Y.&N.J. Tel.	115½	117*	50
Am. Tel. & Cbl.	64½*	70	700	Steel, com.....	46⅞	47	280,430
Am. T. & T...	131	129¼	14,850	Steel, pfd.....	111¾	110¾	31,150
B. R. T.....	51⅜	52¾	26,760	W. U. T.....	57	61½	10,000
Gen. Elec.	146¾	145	1,000	West'h, com....	75½	74½	2,500
Int.-Met., com..	11⅜	11¾*	4,044	West'h, pfd....	95	95*	——

PHILADELPHIA.

	Sept.4	Sept.14	Shares Sold		Sept.4	Sept.14	Shares Sold
Am. Rys.....	45	45*	——	Phila. Elec.....	9⅞	9⅞	——
Elec. Co. of A..	9⅞	10	——	Phila. R. T....	14	20¾	——
Elec. Stor. B'ty.	38½	38½	——	Phila. Traction.	89*	88¼	——
E. S. B'ty, pfd.	49*	49*	——				

CHICAGO.

	Sept.4	Sept.14	Shares Sold		Sept.4	Sept.14	Shares Sold
Chi. City Ry...	176¼	176½*	——	Met. El., com..	16*	16*	——
Com. Edison...	107*	107½	——	Met. El., pfd...	43½	43½*	——
Chi. Subway....	20½	20½*	——	Nat'nal Carbon.	72½*	72½*	——
Chi. Tel. Co....	148	148	——	Nat. Carb., pfd.	109*	109¼	——

BOSTON.

	Sept.4	Sept.14	Shares Sold		Sept.4	Sept.14	Shares Sold
Am. Tel. & Tel.	131	129½	——	Mass. E.R., pfd.	47	51	——
Comb'ind Tel...	175½*	125	——	Mex. Tel., pfd..	6*	6*	——
Gen. Elec.....	146½	145	——	N. E. Tel'p....	120	119	——
Edison El. Ill...	235	235*	——	W. Tel. & Tel..	7*	7½	——
Mass. Elec. Ry..	9	9½	——	W. T. & T., pfd.	80	80*	——

*Last price quoted.
Shares sold are for week Sept. 7 to Sept. 12.

marked. On the other hand call money advanced to 2½ per cent, the highest figure which has been quoted since January, and foreign rates of exchange rose to a point which caused serious talk of gold exports. The first of this series of important events might easily have been made excuses for an advance, or the change in rates for call funds might have been used to check a buying movement. As a matter of fact these developments had no effect on the market. The real dominating interests in the market appear to be indifferent to the happenings of the day. The traders in the market have sold from time to time in order to take profits, but there is no reason to believe that any of the largest interests engaged in the speculative movement have concluded that the rise is permanently checked. This opinion is strengthened by the fact that on days of small reactions the quantity of stock for sale in the market seems to be limited. While the large interests are still satisfied with the prospects of future improvement it is useless to point out that the stock market is not strictly in accord with other branches of trade, or to call attention to the fact that the loss in net earnings by the railroads during the first half year of 1908 is large, or to show that resumption of activity among industrials is so tardy that dividends are still being cut. The buoyancy in securities is explainable only by the fact that the market reflects invariably the future, not the present, state of business. Railroad officials see a hopeful sign in the report of the car efficiency committee for Sept. 10, which shows a decrease of 30,371 in the number of idle cars. The total number of idle cars is now 222,632, which is but little more than one-half the record mark, reached on April 29. This is the smallest number of idle cars reported during the year. The market on Sept 14 was irregular and without distinctive character. The advances and losses were divided. Money was in better demand at 1½ @ 2 per cent for call loans and 2¾ @ 3¼ for 90-day funds. The quotations in the table are for the close Sept. 14.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent; payable Oct. 21.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent; payable Oct. 5.

Cumberland Telephone & Telegraph Company, Nashville, Tenn., quarterly, 2 per cent; payable Oct. 1.

Chicago Telephone Company, quarterly, 2½ per cent; payable Sept. 30.

Western Union Telegraph Company, quarterly, ½ per cent; payable Oct. 15.

Union Traction Company of Indiana, Anderson, Ind., preferred, semi-annual, 2½ per cent; payable Oct. 1.

Manhattan Railway, New York, quarterly, 1¾ per cent; payable Oct. 1.

Canadian Westinghouse Company, Limited, Hamilton, Ont., quarterly, 1½ per cent; payable Oct. 1.

United Traction & Electric Company, Providence, R. I., quarterly, 1¼ per cent; payable Oct. 1.

West End Street Railway Company, Boston, common, semi-annual, 3½ per cent; payable Oct. 1.

Portland (Ore.) Railway Light & Power Company, preferred, quarterly, 1¼ per cent; payable Oct. 1.

Houghton County Street Railway, Houghton, Mich., preferred, semi-annual, 3 per cent; payable Oct. 1.

Toronto Railway, quarterly, 1½ per cent; payable Oct. 1.

Ridge Avenue Passenger Railway, Philadelphia, quarterly, 6 per cent; payable Oct. 1.

AMERICAN LOCOMOTIVE COMPANY PASSES DIVIDEND.—The directors of the American Locomotive Company decided at their meeting last week to pass the regular quarterly dividend of 1¼ per cent on the common stock. Dividends have been paid at this rate for the past two years. The quarterly dividend of 1¾ per cent was declared on the preferred stock. The annual report of the company for the year ended June 30, 1908, shows that the gross earnings decreased more than $12,000,000 and the net earnings $1,784,315. While the surplus after paying the preferred dividends was $2,776,748, or 11.10 per cent on the common stock, the directors concluded that wise business policy demanded a further accumulation of surplus. In explaining their action the directors issued the following statement: "While the directors believe that the business of the country is returning gradually to normal conditions, the business of the American Locomotive Company will be among the last to feel material improvement, and the return of normal demand for its products does not seem probable in time to avoid a material decrease in the financial results for the ensuing year. For these reasons the directors believe it is better to conserve the working capital and surplus of the company." The working capital of the company at the end of the fiscal year is given as $13,125,933. During the year $500,000 was charged off for replacements and maintenance.

CHICAGO TELEPHONE COMPANY'S SURPLUS.—The directors of the Chicago Telephone Company have determined to issue certificates to stockholders to the amount of $4,500,000, thus reducing the $7,332,030 of undivided profits to $2,832,030. After the distribution, which amounts to one new share for five now held, the capital stock will stand at $27,000,000. There are now 220,000 telephone stations owned by the company so that the capitalization is $125 per station. In order to provide for new construction the company will issue $3,000,000 of 6 per cent first mortgage bonds. Practically the entire Chicago service is in cables and the greater portion of these cables in underground conduits. The underground system covers not only the entire city but extends to Waukegan on the north and will soon form part of an all-underground service to Milwaukee. In other directions the underground system extends considerably beyond the city limits east, west, south and southwest.

TELEGRAPH BUSINESS BETTER.—The Western Union Telegraph Company's preliminary report for the quarter ended September 30 shows that business has improved considerably

and that by the adoption of a rigid policy of economy a balance is shown on the right side of the ledger. This estimate indicates a net surplus, after paying fixed charges and one-half of 1 per cent dividend for the quarter, of $769,149, which compares with an actual deficit for the same quarter last year of $1,961,580. While the earnings of the company were sufficient to warrant a resumption of the quarterly dividend rate of 1¼ per cent, it was considered wiser to remain on the lower basis.

BOSTON EDISON COMPANY'S EARNINGS INCREASE.—The statement of the Edison Electric Illuminating Company of Boston for the fiscal year ended June 30, 1908, shows that the company earned a net return of $1,522,273 on the capital stock or about 12 per cent. The earnings for the previous year were 11.05 per cent. The betterments put into the property during the year cost $1,435,366, which compares with an expenditure for similar purposes of $1,278,720 in the previous year. The total betterments since 1903 have involved the expenditure of $8,697,876. The policy of the management is to charge annually an amount equal to about 4 per cent of the capital stock to maintenance, and such charges have equaled approximately 12 per cent of the gross earnings. Last year the ratio to stock was 3.98 per cent and to gross 11.91 per cent. During the past five years $1,836,000 has been set aside for maintenance.

NATIONAL BATTERY COMPANY.—Mr. E. B. Cottrill, president of the National Battery Company, Buffalo, N. Y., states that the receivership under which the company has been operating since February 1 has terminated, all claims having been settled and the property restored to the stockholders. Full control of the reorganized company has been secured by the Cutler-Hammer Company, of Milwaukee, and the concern has resumed the active production of its storage batteries for power, automobile, sparking or other purposes. Under the new management and with ample capital for all requirements, the National Battery Company is well prepared for its share in the industry.

COMMONWEALTH EDISON COMPANY.—A director of the Commonwealth Edison Company of Chicago is quoted as saying that the annual dividend rate will be increased from 5 to 6 per cent at the meeting of directors to be held the latter part of this month. Stock dividends and rights to subscribe for new securities at par are among the inducements held forth to present stockholders. The company is spending at the rate of $4,000,000 per year, but it has $2,000,000 on hand. Some of the money now going into improvements is coming out of surplus earnings, and a stock dividend may be made to reimburse the shareholders.

VIRGINIA PASSENGER & POWER COMPANY.—The reorganization committee of the Virginia Passenger & Power Company and controlled lines has announced that the time for depositing securities under the reorganization plan has been extended until Oct. 15. More than 55 per cent has been deposited, which practically assures the success of the undertaking.

ROANOKE TRACTION & LIGHT COMPANY.—The Roanoke (Va.) Traction & Light Company will issue $3,000,000 of bonds. The Baltimore Trust & Guarantee Company will be trustee. The company was recently incorporated with an authorized capital stock of $2,000,000. At present, it is the intention of the company to issue only $1,000,000 of stock and $250,000 of bonds.

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY.—The New England Telephone & Telegraph Company has secured control of the Northeastern Telephone Company, the Lewiston-Auburn Telephone Company, and the Cumberland Telephone Company, three independent properties, operating in 25 towns and cities in Maine.

REPORTS OF EARNINGS

	Gross earnings.	Operating expenses.	Net earnings.	Charges.	Surplus.
Rutland (Vt.) Railway, Light & Power Company:					
Year ended Aug. 31, 1908	$254,527	$138,137	$116,390	——	——
Year ended Aug. 31, 1907	233,298	135,669	97,629	——	——
Oneonta & Mohawk Valley Railroad:					
April 1 to June 30, 1908	$45,975	$44,935	$1,040	$11,352	*$9,965
April 1 to June 30, 1907	42,098	38,974	3,151	11,313	*$7,979
Charlestown (Mass.) Gas & Electric Company:					
Year ended June 30, 1908	$324,704	——	$75,157	$7,843	$67,413
Year ended June 30, 1907	297,288	——	60,530	4,393	66,137
Malden & Melrose Gas Light Company, Malden, Mass.:					
Year ended June 30, 1908	$304,586	$220,144	$84,472	——	$7,236
Year ended June 30, 1907	221,271	173,131	48,140	——	8,641
Newburyport (Mass.) Gas & Electric Company:					
Year ended June 30, 1908	$88,878	$60,692	$28,186	——	$11,086
Year ended June 30, 1907	80,533	57,464	23,069	——	6,682
Hudson Valley Railway Company:					
April 1 to June 30, 1908	$145,547	$113,522	$32,295	$55,886	*$22,442
April 1 to June 30, 1907	145,193	103,432	41,761	50,788	*6,770
American Telephone & Telegraph Company:					
July, 1908	$10,014,300	$7,175,100	$2,839,200	$627,200	$2,665,600
July, 1907	9,543,100	7,301,900	2,241,200	605,300	2,065,000
United Traction Company (Albany, N. Y.):					
April 1 to June 30, 1908	$498,245	$305,027	$193,218	$91,884	$130,675
April 1 to June 30, 1907	512,511	294,383	218,128	87,482	166,537
Keystone Telephone Company (Philadelphia):					
Year ended June 30, 1908	$1,051,071	$539,123	$511,948	$413,112	$98,836
Year ended June 30, 1907	995,752	522,036	473,716	365,976	107,740
American Locomotive Company:					
Year ended June 30, 1908	$37,484,417	$32,497,627	$4,986,790	$460,042	$2,776,748
Year ended June 30, 1907	49,515,486	42,744,381	6,771,105	412,898	2,608,207
Edison Electric Illuminating Company (Boston):					
Year ended June 30, 1908	$4,229,239	$2,690,419	$1,538,820	$54,989	$1,522,273
Year ended June 30, 1907	4,020,621	2,591,823	1,428,798	102,417	1,367,721
Portland (Ore.) Railway, Light & Power Company:					
July, 1908	$384,169	$191,813	$192,356	——	——
July, 1907	378,560	188,080	190,481	——	——
St. Joseph (Mo.) Light, Heat & Power Company:					
July, 1908	$80,739	$38,786	$41,952	——	——
July, 1907	78,284	38,483	39,800	——	——
Hyde Park (Mass.) Electric Light Company:					
Year ended June 30, 1908	$110,602	$79,178	$31,424	$20,125	$11,298
Year ended June 30, 1907	107,176	79,241	27,025	20,125	7,810

*Deficit.

GENERAL NEWS

Construction News.

GADSDEN, ALA.—The City Council has granted the Etowah Light & Power Company, of Attalla, Ala., a franchise to erect transmsision lines for the distribution of electricity in the city. The company agrees to have its system ready for service within 18 months. Plans are being prepared by Solomon-Norcross Company, of Atlanta, Ga., for the proposed hydro-electric power plant on Coosa River at lock No. 2 to be built by the Coosa River Electric Power Company. From 25,000 to 30,000 hp will be developed. R. H. Cobb is president.

GIRARD, ALA.—The Phoenix-Girard Electric Light & Power Company, recently incorporated, has been granted a franchise to furnish electricity in Girard for lamps and motors. I. I. Moses and D. C. Foster, of Girard, and J. L. Bass, of Columbus, Ga., are interested in the enterprise.

HUNTSVILLE, ALA.—E. L. Pulley and associates, who have organized the Huntsville, Chattanooga & Birmingham Railway, Light & Power Company, it is stated, have purchased the stock owned by T. Coleman Dupont and John H. Walters in the Huntsville Railway, Light & Power Company, thereby securing a controlling interest in the company. A franchise was recently granted to E. L. Pulley to construct an electric railway in Huntsville.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company is planning to build a new transmission line from Montgomery to Tallassee, Ala., a distance of 30 miles in order to improve the service in that vicinity. The improvements contemplated by the company will involve an expenditure of about $100,000.

NEW DECATUR, ALA.—The Decatur Cornice & Roofing Company is planning to build an addition to its manufacturing plant and will double its manufacturing facilities. The plant will be operated by electricity with individual electric motor-driven machinery.

WICKENBURG, ARIZ.—The Octave Mining Company has purchased a site in Wickenburg for its proposed electric power plant. The company proposes to erect electric transmission lines from the plant to the Octave Camp through the Weaver District, and will also make arrangements to furnish electrical energy to the mines in the southern part of Maricopa County, provided there is a demand for it.

LITTLE ROCK, ARK.—The city has recently installed a new engine and generator in the Argenta electric light plant to furnish electricity for operating the electric railway system of the Argenta Railway Company.

LITTLE ROCK, ARK.—Contracts have been awarded by Mayor W. C. Faucette for equipment for the municipal electric light and power plant as follows: To the Ideal Engine Company, of Springfield, Ill., for engine, and to the Fort Wayne Electric Works, Fort Wayne, Ind., for electrical equipment. An appropriation of $12,000 was recently made by the City Council for this purpose.

NASHVILLE, ARK.—Application has been made to the town by Robert Crowe, of Arkadelphia, Ark., for a franchise to erect and operate an electric light plant in Nashville.

BISHOP, CAL.—The Nevada-California Power Company, of Tonopah, Nev., contemplates the construction of an 3000-hp plant at Bishop Creek, Cal. This will make the fourth plant erected by the company, which when completed will give it a total output of 26,000 hp. Work on the new plant will commence as soon as the present plant now under construction is completed. Manhattan and Round Mountain are to be connected by long-distance transmission lines, which will be completed by spring. Electricity will be furnished to mines and other plants in southern Nevada. D. A. Chappell, of Denver, Col., is manager.

EUREKA, CAL.—Plans are being made by Captain Walter Coggeshall, of the Coggeshall Lamp Company, for establishing an amusement park on Humboldt Bay. It is proposed to install a gasoline power plant to generate electricity for illuminating the grounds.

OAKLAND, CAL.—The Board of Public Works has issued a permit to the Oakland Gas, Light & Heat Company for the construction of a building on First Street, to cost $35,000, which will be equipped with new turbine engines burning crude oil, and a new auxiliary plant, which will be used for supplementary power, or in the case of emergency. Other improvements are contemplated by the company which include the erection of additional transmission lines and the construction of new mains.

DENVER, COL.—The stockholders of the Denver City Tramway Company have authorized an issue of $25,000,000 in bonds, of which $13,000,000 are to be set aside for retiring outstanding bonds, and $12,000,000 are to be used as new electric railways and extensions are added to the system, and then only to the amount of the actual cost of the improvements, and only in case the net earnings at the time are at least 150 per cent of all interest charges.

GRAND JUNCTION, COL.—Surveys are nearly completed and the rights of way secured for the proposed electric railway to be built by the Grand Junction, Palisade & Plateau Valley Railway Company which is to connect Grand Junction and Palisades, Col., a distance of 17 miles. The power station will be located at Grand Junction. E. A. Sunderlin is general manager.

DANIELSON, CONN.—Bids are being asked for the construction of a masonry dam and power house foundations on the Quinebaug River in Killingly and Pomfret, Conn., for the Danielsonville Cotton Company. E. Worthington, of Dedham, Mass., is engineer.

MERIDEN, CONN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Oct. 2 for an electric push button mail lift in the United States Post Office, Meriden, Conn., in accordance with drawing and specifications, copies of which may be obtained at the office of the superintendent of construction, Meriden, Conn. James Knox Taylor is supervising architect.

STONINGTON, CONN.—The American Velvet Company has awarded the contract for the construction of the addition to the power house at its mill to Sherman & Sons. When completed the additional space will be used for the new electrical equipment which the company proposes to install.

WASHINGTON, D. C.—Proposals will be received by the Secretary of Agriculture until Sept. 20 for furnishing materials and labor for installing, complete, boilers, mains, return pipes, etc.; also feeders for electric light and power purposes for the Weather Bureau, U. S. Department of Agriculture, at Mt. Weather, Va., in accordance with plans and specifications, which may be obtained from Newton & Painter, engineers, Professional Building, Baltimore, Md., and the U. S. Weather Bureau (accounts division), Washington, D. C. M. W. Hays is acting secretary.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 3, for furnishing four 1,000-kw and two 500-kw, alternating-current turbo-generator sets for the navy yards, New York, N. Y., Philadelphia, Pa., Norfolk, Va., Mare Island, Cal., and Bremerton, Wash. Plans and specifications can be obtained on application to the bureau or to the commandants of the navy yards named. William M. Smith is acting chief of bureau.

LAKELAND, FLA.—At an election held recently the citizens voted against the proposition to issue $15,000 in bonds for the construction of a municipal electric light plant.

LAKEVIEW, FLA.—J. R. McQueen, of Lakeview, and J. B. Eastwood, of Carthage, N. C., are interested in a project to build an electric power plant to furnish electricity for lamps in Lakeview, Vass and Cameron.

ST. AUGUSTINE, FLA.—The St. Johns Light & Power Company has submitted a proposition to the City Council offering to furnish incandescent electric lamps of 50 cp at the rate of $2.95 per lamp per month, or to furnish electricity at the rate of 5 cents per kw-hour, for lighting the streets of the city.

ST. PETERSBURG, FLA.—The St. Petersburg Electric Light & Street Railway Company is planning to build an addition to its plant, and will install additional machinery, the cost of which is estimated at $15,000. The new equipment will include a 400-hp Corliss engine, a 250-kw dynamo and a 250-hp boiler.

SANFORD, FLA.—M. M. Smith, president of the People's Bank, has applied to the City Council for a franchise to establish an electric light plant in Sanford.

SANFORD, FLA.—Application has been made to the City Council by S. O. Chase, A. T. Rossiter, A. P. Connolly, F. P. Forster and J. N. Whitner for a franchise to build and operate a street railway system in Sanford. It is proposed to organize a company, to be known as the Sanford Traction Company.

BYROMVILLE, GA.—We are informed that work on construction of the electric light plant is under way, and machinery for the plant has been purchased. S. J. Murray is general manager.

BYROMVILLE, GA.—Plans are being considered for the construction of an electric light plant, ice factory and planing mill in Byromville. Seymour Byrom is interested in the project.

MACON, GA.—B. L. Jones contemplates installing an electric light plant to furnish electricity for 150 lamps in connection with club buildings.

SMITHVILLE, GA.—Wells Brothers are contemplating the installation of an electric light plant at their mills, located about one mile from the city. The plant will be operated by water power and will supply the city with 500 lamps. Contracts for the machinery have been placed.

MILNER, IDAHO.—D. C. McWatters, president of the Milner & North Side Railroad Company, states that its electric railway will be completed to Wendell by Oct. 15. The system, when completed, will be 65 miles in length, and electricity for operating the road will be furnished by two plants, one located at Shoshone, and the other at lower Salmon Falls.

ROCKFORD, ILL.—Extensive improvements are contemplated by the Rockford Electric Company, including the reconstruction of the hydro-electric plant. Additional water wheels and generators direct connected

will be installed. The company is now installing a 30-kw, three-phase, synchronous motor direct connected to a 550-volt rotary converter. Orders have been placed for a 535-kw, three-phase, synchronous motor direct connected to 250-kw, 275-volt, direct-current machines. The cost of the work is estimated at about $40,000.

DARLINGTON, IND.—Bids will be received by the Board of Trustees until Sept. 18 for the construction of an electric light plant, the cost of which is estimated at $3,000. N. A. Booher is clerk.

DECATUR, IND.—The Fort Wayne & Springfield Railway Company has awarded contracts to the Electric Traction Supply Company for all overhead construction material for a 12-mile extension to its system.

EVANSVILLE, IND.—The Evansville, Princeton & Vincennes Railway Company has completed its extension to Patoka, and is now said to be planning for an extension through Knox and Sullivan Counties, connecting with the Terre Haute, Indianapolis & Eastern Traction Company's system, affording a through service from Evansville to Indianapolis.

GOSHEN, IND.—The City Council is considering the question of rebuilding the municipal commercial electric lighting plant, the cost of which is estimated at from $25,000 to $50,000. The water works and light committee is preparing plans for a new arc lamp system, which will include the installation of a 600-hp engine, a 500-kw generator, three transformers, switchboard and 150 enclosed arc lamps.

INDIANAPOLIS, IND.—The Commissioners of Marion County are negotiating with the Indianapolis Light & Heat Company to take over and operate the county light, heat and power plant and operate it for a stated amount. The Commissioners practically admit that county ownership of the plant is a failure.

INDIANAPOLIS, IND.—We are informed that the Ferdinand Railway Company is planning to begin work on the construction of its proposed electric railway between Huntingburg and Ferdinand, Ind., next month. The road will be 7 miles in length. The officers are: O. W. Blickenstaff, president; C. M. C. Shanks, vice-president; D. H. Morgan, secretary; N. P. Carter, treasurer; H. E. Huntington, general manager, and C. A. Morgan, electrical engineer.

LOGANSPORT, IND.—The City Council has awarded a contract to the Westinghouse Electric Company, of Pittsburg, Pa., for the furnishing of machinery, etc., for the re-equipment of the municipal electric light plant.

MICHIGAN CITY, IND.—The Central Union and the Merchants' Mutual Telephone Companies have been consolidated. By the terms of the agreement the property of both companies will be taken over by a new company. The patrons of both companies will all be connected with the Central Union and the Independent long-distance lines.

OSSIAN, IND.—The Town Council is considering a proposition submitted by the Fort Wayne & Wabash Valley Traction Company for street and residence lighting service in the town. The company proposes that the town build a substation 40x60 ft. to be leased by the company for a term of years with the privilege of purchase, in return for which the company will erect an overhead distributing system and place 20 street lamps in the town and furnish electricity to light the residences and stores at the same rate charged for the same service in Fort Wayne. The minimum house service charge has been placed at $1 per month.

PETERSBURG, IND.—The exchange of the Petersburg Telephone Company was damaged by fire on Sept. 7. The company will build a new exchange and install a new switchboard.

SOUTH BEND, IND.—The Northern Indiana Railway Company is planning to extend its system three miles north of Elkhart to Simonton Lake, for the purpose of establishing a pleasure resort. When this is completed the company will extend its railway to Eagle and Christian Lakes, 4 miles north of Simonton Lake.

TERRE HAUTE, IND.—The Grand Central Traction Company has been granted a 40-year franchise for an entrance to the city. The company proposes to construct an electric railway from Indianapolis to Evansville, Ind., with a branch from Bloomington to Terre Haute.

ATLANTIC, IA.—Bids will be received by T. E. Nichols, city clerk, until Sept. 22, for a 80-hp engine, one 50-kw and one 30-kw generator, a switchboard and a compound, direct-acting pumping engine.

DANBURY, IA.—The question of establishing a municipal lighting plant in Danbury is under consideration.

ELDORA, IA.—At a special election held recently the citizens voted to grant a 5 per cent tax on all of the property in Eldora to the Iowa Railroad Company, and a 25-year franchise giving the company the right to lay its tracks through the streets of the town. Special elections will soon be held in the cities of Hubbard, Radcliffe and Story City, Ia., at which time the citizens will vote on the proposition to grant a franchise and a 5 per cent tax to the above company.

GLENWOOD, IA.—The Iowa Telephone Company contemplates making extensive improvements and extensions to its telephone system in Glenwood.

IOWA CITY, IA.—The Rundell Land & Improvement Company, represented by Henry Negus and J. J. Hamiel, has applied to the City Council for a franchise to construct and operate a street railway 5 miles in length in Iowa City.

TABOR, IA.—An election will be held Sept. 21 to vote on the proposition of granting a franchise to the Malvern Light & Power Company, of Malvern, Iowa, to erect and operate an electric light, heat and power system in Tabor.

CHAPMAN, KAN.—The local electric light plant was sold Sept. 2 at a sheriff's sale to M. P. Sanford and C. Downing for $2,000.

ELLINWOOD, KAN.—Plans are being prepared by W. K. Palmer, engineer, of Kansas City, for the construction of a municipal electric light plant.

KIOWA, KAN.—Bids will be received by C. H. McBrayer, city clerk, until Oct. 2, for furnishing material and constructing an electric light plant and water works system, separate bids to be submitted, as follows: (1) For furnishing materials and labor (except cast iron pipe, hydrants and valves, electrical machinery, pumping machinery, steam engine) and constructing electric light and water works system; (2) for furnishing cast iron pipe and special castings; (3) for furnishing hydrants and valves; (4) for furnishing two 500-gal. per minute steam pumps and one 200-gal. per minute triplex power pump; (5) for furnishing generator, switchboard, motor, transformers and arc lamps; (6) for one 125-hp high-speed engine; (7) for furnishing material and erecting steel tower and tank 100 ft. high, with capacity of 70,000 gal. Plans and specifications are on file at the office of the city clerk, and at the office of Burns & McDonnell, engineers, Kansas City, Mo. Extra copies of the plans may be obtained from the engineers by making a payment of $5 to cover the cost of the prints. J. N. Herr is mayor.

MOUNDRIDGE, KAN.—The citizens have voted to issue $11,000 in bonds for the construction of an electric light plant and $17,500 for water works system.

BRUNSWICK, MAINE.—The Brunswick Electric Light & Power Company has awarded the contract for the construction of its power house in Brunswick to R. D. Shanahan, of Portland, Maine.

CUMBERLAND, MD.—It is reported that C. L. Pullen, vice-president, and other officials of the Western Maryland Coal & Coke Company, and John Bogart, of New York, N. Y., have recently visited the coal lands of the company in Garrett County, with a view of ascertaining the feasibility and the cost of constructing a large power plant on the property by erecting a dam on the Youghiogheny River.

HAGERSTOWN, MD.—Arrangements are being made by O. E. Shiffler, C. E. Easterday and H. L. Moser to organize a company to establish an electric light plant.

HAGERSTOWN, MD.—It is reported that plans are being considered to construct an electric railway from Mercersburg to Williamsport, via Fairport. W. D. Bryan & Sons, who operate extensive tanneries at the above places, are said to be interested in the project.

BOSTON, MASS.—Bids will be received at the U. S. Engineer's Office, Boston, Mass., until Oct. 8 for furnishing and delivering electrical junction boxes and cable. For further information apply to Lieut. Col. Edward Burr.

MARLBORO, MASS.—The Marlboro Electric Company is contemplating extending its transmission lines to Berlin, Mass., to furnish electricity to light the town. The company is now erecting a transmission line from Northboro to Shrewsbury.

NORTHAMPTON, MASS.—The Northampton Electric Light Company is extending its transmission lines from Leeds to Haydenville by the way of Clinton Towers.

TYNGSBORO, MASS.—The citizens are considering the question of lighting the town by electricity, and have submitted a proposition to the Lowell Electric Light Corporation to furnish electricity to light the town, suggesting that the company extend its transmission lines from the Vestry Country Club at Tyngs Island to Tyngsboro.

WEST BOYLSTON, MASS.—The citizens are considering the question of entering into a contract with the Marlboro Electric Light Company for furnishing electricity for lighting the town. The company has submitted a proposition to the Selectmen offering to furnish incandescent lamps of 40 cp for $18 each per year for a term of not less than 10 years.

DETROIT, MICH.—It is reported that the Detroit Edison Company is making arrangements to enlarge and improve its plant according to the original plans, which include duplicating the present plant at a cost of $2,000,000. The new plant will be located in Delray. Plans are also being considered by the company to utilize the water power of the Huron River between Ann Arbor and Ypsilanti. The company is also extending its service toward Mt. Clemens. The new arrangement with the city took effect July 1, under which the price of electricity was reduced from 16 to 14 cents per kw-hour.

GRAND RAPIDS, MICH.—Preliminary arrangements are being made for the transfer of the Lighting Department to the pumping station and the installation of additional machinery to supply electricity for extensions to the street lighting system. Samuel A. Freshney is manager.

HOUGHTON, MICH.—Power for operating the Wolverine Mine, north of Calumet, is being changed from steam and compressed air to electricity. Five triplex electric pumps are now being installed. The Houghton County Electric Light Company will supply electrical energy to operate the machinery. The company will also install several transformers in the engine house.

MORLEY, MICH.—Work has commenced on the construction of the power dam on the Little Muskegon River at Morley. The plant will be located in Morley, and when completed will furnish electricity for Morley and surrounding towns. E. W. Bending, of Grand Rapids, Mich., and Joseph Bicknell, of Muskegon, Mich., are interested in the project.

SAGINAW, MICH.—It is reported that the Commonwealth Power Company has commenced work on the development of the water power of Au Sable River, which will furnish electricity in Saginaw, Bay City and other towns in Saginaw Valley.

SAGINAW, MICH.—The Saginaw & Flint Railway Company has decided to dismantle its power plant in Bridgeport. The company has practically completed negotiations with the Bartlett Illuminating Company, of Saginaw, for electrical energy to operate its present system and projected railway extensions to Flint and Vassar.

YPSILANTI, MICH.—The City Council has granted a 30-year franchise to the Washtenaw Light & Power Company to construct and operate an electric light plant in Ypsilanti. It is said that the company contemplates the construction of a large electric light plant, the cost of which is estimated at $60,000.

AURORA, MINN.—C. E. Moore, of Virginia, Minn., has applied to the town officials for a franchise to erect and operate an electric light plant.

FERGUS FALLS, MINN.—The contract for additional arc lamps and switchboard for the municipal electric light plant has been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for $3,636.

ROYALTON, MINN.—The Royalton Power & Light Company, recently incorporated, has purchased water power rights on the Platte River, and proposes to erect an electric lighting plant, which is expected to be in operation by Nov. 1. Oscar Claussen, of St. Paul, Minn., engineer, is preparing plans for the plant. The officers of the company are: A. C. Wilson, president; Mark Murphy, vice-president; Charles R. Rhoda, secretary and treasurer.

CLARKSDALE, MISS.—The city has awarded contracts as follows: To the Ball Engine Company, of Erie, Pa., for a 540-hp engine; Crocker-Wheeler Company, of Ampere, N. J., for a 300-kw generator, and to the Weber Company, of Memphis, Tenn., for the construction of a concrete steel chimney. Walter G. Kirkpatrick, of Jackson, Mich., is engineer.

HATTIESBURG, MISS.—Plans are being considered to utilize the water power of Bouie River at its confluence with Leaf River, above the city, and to erect a hydro-electric plant to furnish electricity to Hattiesburg for lamps and motors.

JACKSON, MISS.—Plans are being made by the Cumberland Telephone & Telegraph Company to establish long-distance telephone lines between Jackson and Natchez, Miss. Leland Hume is general manager.

LUCEDALE, MISS.—Plans are being considered by the Kansas City Lumber Company to furnish electricity to light the city.

BENBOW, P. O. EWING, MO.—The Village Board has granted the Benbow City Light, Power & Heat Company a 25-year franchise to construct and operate an electric light plant in the village; also to furnish electricity for power and to operate a hot water heating plant. The cost of the plant to be installed by the company is estimated at $60,000.

CARTHAGE, MO.—The Empire Electric Power & Supply Company has placed orders for machinery in connection with the development of the Forest Mills water power recently purchased by the company. The present dam will be raised and three-phase generators installed. It is expected to have the plant in operation by Nov. 15, which will have a minimum output of from 175 to 200 hp. T. T. Luscombe is president of the company.

FESTUS, MO.—It is reported that the City Council of Festus has offered to sell the municipal electric light plant to a St. Louis syndicate for $10,000.

KANSAS CITY, MO.—The Utilities Commission has made arrangements with W. F. Lyons for an electric light franchise in this city east of Cleveland Avenue, under which Mr. Lyons agrees to pay into the city treasury 2 per cent of the annual gross receipts.

ST. LOUIS, MO.—The Missouri Electric Railroad Company, organized recently to take over the St. Louis, St. Charles & Western Railroad Company, has filed a mortgage to the Mercantile Trust Company, of St. Louis, Mo., as trustee, to secure an issue of $1,000,000 in bonds, of which $700,000 are reserved to refund the present indebtedness and for extending and repairing the system.

BEARCREEK, MONT.—Yager Brothers are contemplating the construction of an electric light and power plant at the Bearcreek coal mines. N. S. Poole, of Townsend, Mont., is engineer.

GREAT FALLS, MONT.—Preliminary steps have been taken toward the organization of a company to construct and operate an electric railway between Great Falls and Choteau, of which Dr. A. F. Longeway, of Great Falls, is the principal promoter. The cost of the road is estimated at from $15,000 to $20,000 per mile. The company proposes to tap the Sun River irrigation project and the adjoining irrigated lands. The citizens of Choteau have agreed to raise a bonus of $150,000 for the project. The county has granted the promoters a franchise to use the county roads.

JOLIET, MONT.—The Joliet Water & Light Company has been incorporated and proposes to furnish Joliet with water and electric light under a 25-year franchise granted to A. F. McCune. Electricity will be generated by water taken from Rock Creek by means of a 36-in. pipe, one mile in length, having a 68-ft. fall. Charles Natman, of Bozeman, Mont., is attorney.

TOWNSEND, MONT.—Henry M. Ogden, manager of the municipal electric light plant, writes that it is proposed to increase the equipment of the plant, and that the city would like to receive prices on a 60 or 70 kw, single-phase, 60-cycle, alternating-current generator with pulley and exciter. Estimates must be submitted by Oct. 1.

GRESHAM, NEB.—The question of establishing an electric light plant in Gresham is reported to be under consideration.

McCOOK, NEB.—The City Council has passed an ordinance granting a 20-year franchise to the McCook Electric Light Company.

PENDER, NEB.—R. P. Mason, village clerk, writes that plans are being made to issue bonds about Oct. 1, and advertise for bids for the construction of a municipal electric light plant.

WYMORE, NEB.—It is reported that an election will be held to vote on the proposition of establishing a lighting system in the town.

ROCHESTER, N. H.—The Dover, Somersworth & Rochester Street Railway Company has been granted a franchise by the City Council for the right of way for the proposed electric railway between Rochester and East Rochester, work on which, it is expected, will begin immediately.

BUTLER, N. J.—A franchise has been granted to the Kennedy Electric Company by the Borough of Butler for the construction of an electric lighting system. A producer gas power plant will be installed to furnish electricity to light the Borough of Butler, and also Bloomingdale and Pompton Plains.

NEWARK, N. J.—The contract for the construction of the addition to the power plant at the penitentiary has been awarded to Storms & Company, of Newark, for $13,454.

PERTH AMBOY, N. J.—A committee has been appointed by the City Council to investigate the question of establishing a municipal electric light plant, and to see what the local electric light company will sell its plant to the city for. The Sayre & Fisher Electric Light Company has submitted a proposition to the Council offering to furnish the city with electricity to operate the plant at the rate of 4½ and 4¾ cents per kw-hour; also to install a plant similar to the present plant for $5,400.

RATON, N. M.—H. N. Siegfried, of Denver, Colo., general manager of the Southern Colorado Power Company, is said to be interested in a project to install an electric light plant and street car system in Raton.

SANTA FE, N. M.—Application has been made to the Territorial Engineer, by J. P. Conner, of Santa Fe, for water rights of the Pascos River, 20 miles east of Santa Fe, where it is proposed to install a hydro-electric plant with an output of 4000 hp to supply Santa Fe, Las Vegas, Albuquerque and the Estanvia Valley with electrical power. The cost of the plant is estimated at $20,000.

BUFFALO, N. Y.—The Cataract Power & Conduit Company has applied to the Public Service Commission for permission to issue $120,000 in bonds, the proceeds to be used for the acquisition of property and for extensions and improvements to the plant.

FORT ANN, N. Y.—The Public Service Commission has granted the Kane Falls Electric Company permission to erect an electric transmission line in the towns of Fort Ann and Kingsbury, in Washington County, and Queensbury, in Warren County, N. Y.

GARDENVILLE, N. Y.—The Buffalo Southern Railway Company is planning to build a five-mile extension from the Union road in the towns of Cheektowaga and West Seneca to the city line of Buffalo, and is also planning to construct an electric railway from the junction of the Buffalo and Aurora plank road and Union road in West Seneca to East Aurora, a distance of 11½ miles. William H. Cummings is president.

LONG ISLAND CITY, N. Y.—The New York & Queens County Railway Company has been granted a franchise for the construction of the double-track extension from Flushing to Bayside and Whitestone, 5 miles in length. It is said that work will soon commence on the construction of the road.

MINEOLA, N. Y.—The Board of Supervisors of Nassau County has granted the New York & North Shore Traction Company a franchise to construct and operate an electric railway along Broadway, Hicksville from John street to the Long Island Railroad, also to cross the Rosslyn Road opposite Clinton avenue in Mineola.

NEW YORK, N. Y.—Bids will be received by J. W. Stevenson, Commissioner of Bridges, until Sept. 24 for the installation of electric wiring, lamps, fixtures, etc., for lighting the Blackwell's Island Bridge. Blank forms and specifications may be obtained at the office of the Department of Bridges, 13 to 21 Park Row, Borough of Manhattan.

NEW YORK, N. Y.—Bids will be received by the Park Board at the office of the Department of Parks, Arsenal Building, Fifth Avenue and Sixty-fourth Street, until Sept. 24, for all labor and materials required for changes in electric circuit work, fire-alarm and watchman's detector system, night lighting system, changes in elevators, etc., for the Metropolitan Museum of Art. Blank forms may be obtained and plans may be seen at the above office. Henry Smith is president of the board.

RIVERHEAD, N. Y.—Harry B. Howell, of Riverhead, and G. Frank Tuthill, of Greenport, N. Y., are reported to be interested in a project to build an electric railway between the county seat and Orient Point, with feeders from South Jamesport, New Suffolk and other towns off of the main highway.

SHORTSVILLE, N. Y.—Bids will be received by the Board of Trustees until Sept. 22 for the construction of a complete water works system, to include a duplicate pumping plant with triplex pumps and gasoline or electric power, elevated tank, cast iron pipe, etc.

SYRACUSE, N.Y.—The Syracuse, Lake Shore & Northern Railroad Company is considering plans for the construction of an extension of its system to Oswego, N. Y., a distance of 11 miles.

SYRACUSE, N. Y.—The Auburn & Syracuse Electric Railroad Company is reported to be considering the construction of an electric railway from Auburn to Seneca Falls, a distance of 15 miles.

SYRACUSE, N. Y.—The Rochester, Syracuse & Eastern Railroad Company is making preliminary surveys for an electric railway between Port Byron and Syracuse, a distance of 25 miles. T. H. Mather is chief engineer.

WHITE PLAINS, N. Y.—The Tarrytown, White Plains & Mamaroneck Railway Company has made an arrangement with the Westchester Lighting Company whereby the latter company is to furnish electricity for operating the system of the street railway company. Three additional transmission lines will be erected between New Rochelle and White Plains.

WILLIAMSON, N. Y.—The citizens are considering a proposition of lighting the streets of the town by electricity. If it is decided to have the streets lighted the service will be supplied by the Sodus Gas & Electric Light Company, which is now furnishing residences and stores in the town with electricity for lamps and motors.

LAKEVIEW, N. C.—Plans are being considered for installing an electric light plant in the Lakeview Mills to supply electricity in Lakeview and adjoining towns. A 75-hp. water wheel will be installed. The cost of the plant is estimated at $5,000. J. B. Eastwood and J. R. McQueen are interested in the enterprise.

TRYON, N. C.—It is reported that the Tryon Electric Light, Water & Power Company is preparing plans for the construction of an electric light plant.

GRAND FORKS, N. D.—The question of placing the electric light wires underground in this city is under consideration.

COLUMBUS, OHIO.—At a meeting of the stockholders of the Columbus Railway & Light Company held recently the lease of the properties of the Columbus Public Service Company was ratified. The lease is for a period of 50 years and includes all the grants and the good will of the properties, which are to be taken over by the Columbus Light, Heat & Power Company.

COLUMBUS, OHIO.—S. S. Wyer, consulting engineer, Harrison Building, Columbus, Ohio, has been appointed by the National Fire Equipment Company to prepare plans and specifications for a complete electric lighting system and water works for one of the Columbus suburban towns. Contracts will be let for the work, which will include the installation of gas engines, fire pumps, deep well pumps, electric generators, switchboards, arc lamps, water mains, valves and fire hydrants, elevated tank, etc. Contracts will also be let for erecting transmission lines, installing lamps, erection of pump house, laying water mains, etc.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company has made a proposition to furnish 250 arc lamps for the city at $66 per lamp per year. This would give the city 45 more lamps than it has been using and at the same time make a saving of $307.50 per year over what is now being paid for lighting the streets of the city.

LIMA, OHIO.—The Board of Public Service has appointed J. Walter Esterline, electrical engineer, of Lafayette, Ind., to draw plans and specifications for the proposed municipal electric light plant. In the report made by Mr. Esterline some time ago the cost of the plant was estimated at $71,000.

LIMA, OHIO.—Judge Mathers has made permanent the injunction to prevent the City Council from reconsidering its action in passing an ordinance providing for the construction of a municipal lighting plant to cost $80,000. After the Council had taken action on the matter, two of the members changed their minds and called a meeting for the day before the ordinance took effect. Friends of the municipal plan secured a temporary restraining order which was served before a vote could be taken. The Lima & Toledo Traction Company is now furnishing electricity for lighting the city and has made a hard fight to prevent the city from preparing for a municipal plant. Several excellent offers have been turned down by the City Council.

NEW BREMAN, OHIO.—The contracts for the new municipal electric lighting plant here have been awarded as follows: Western Electric Company, of Chicago, Ill., for generating unit; St. Marys Machine Company, of St. Marys, Ohio, for gas engines, and Westingbouse Electric & Manufacturing Company, of Pittsburg, Pa., for switchboard and connections. The generator will cost $5,500.

NEW CONCORD, OHIO.—The City Council is considering the question of establishing a municipal electric light plant. It is stated that it is proposed to convert the Drummond flour mill into a power plant.

WEST LIBERTY, OHIO.—The local electric light plant owned by Jonas Yoder has been sold to R. M. Kelly, of Odessa, Wash.

CHICKASHA, OKLA.—The Public Service Company, it is reported, contemplates increasing the output of its gas, electric and water plants, and also the ice manufacturing plant. C. T. Blake is president.

FORT GIBSON, OKLA.—The local electric light plant was entirely destroyed by fire Sept. 1, causing a loss of about $20,000. The plant had been in operation about six months. Frank Boudinot is president of the company, and Perry Pyles, secretary.

CLATSKANIE, ORE.—Announcement has been made that the Clatskanie & Nehalem Valley Electric Railway Company will award contracts within the next 60 days for the construction of its proposed electric railway from Clatskanie through the Nehalem Valley for a distance of about 30 miles, surveys for which have been completed. A. B. Kurtz, of Clatskanie, is president of the company, and J. H. Abbott, of Portland, Ore., is chief engineer.

FAIRVIEW, ORE.—A movement is on foot to erect an electric light plant to furnish electricity to light the town.

MARSHFIELD, ORE.—Seymour H. Bell, treasurer and general manager of the Coos Bay Railway Terminal Company, writes that work has commenced on the construction of the electric railway which is to connect Empire City, North Bend, Marshfield and Eastside. The overhead trolley system will be used, and electricity for operating the system will be secured from the Coos Bay Gas & Electric Company, of North Bend, Ore., which is owned by the railway company.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Sept. 28, for equipment for an electrical industrial railway, consisting of 15,600 ft. of trackage, with 12 electric locomotives and 24 flat cars, as per Circular 465. Captain F. C. Boggs is general purchasing officer.

BLOOMSBURG, PA.—The Bloomsburg & Millville Street Railway Company has awarded a contract to Lawrence & Company, of Chicago, Ill., for the construction of an electric railway to connect Bloomsburg and Millville, Pa., work on which will be begun at once. It is expected to have the road in operation by the middle of November. C. W. Miller is president.

CLARION, PA.—Application will soon be made by A. R. Lobaugh, E. M. Heeter, G. H. Holliday, N. M. Meals and A. R. Pollock for a charter to incorporate the Callensburg Telephone Company. It is proposed to erect and operate a telephone system in the boroughs of Callensburg, West Freedom, Leatherwood, Sligo and neighboring towns.

DUQUESNE, PA.—The Duquesne & Dravosburg Street Railway Company has applied to the Borough Council for a franchise to construct an electric railway on several streets in the borough. The company proposes to build an electric railway to Dravosburg and West Elizabeth.

HATFIELD, PA.—The citizens on Aug. 29 voted to issue $4,000 in bonds, the proceeds to be used for the construction of an electric light plant.

PATTON, PA.—The Northern Cambria Street Railway Company has awarded a contract to the Barnesboro Construction Company for the construction of its system from Barnesboro to Hastings. W. H. Denlinger, of Patton, is president.

PHILADELPHIA, PA.—The Wyoming Valley Gas & Electric Company, of Plymouth, Pa., and the Luzerne County Gas & Electric Company have been consolidated under the name of the Luzerne County Gas & Electric Company.

POTTSVILLE, PA.—Contracts have been signed for the construction of an electric transmission line from Tower City to Lykens, a distance of 10 miles. A power house will be erected on the Schuylkill side of Williamstown, about the center of the line.

WELLSBORO, PA.—W. A. Selts, of Jersey Shore, Pa., has applied for a franchise to build a street railway system in the city of Wellsboro. The company will be organized under the name of the Tioga Traction Company and proposes to extend the railway to Mansfield by the way of Wellsboro street.

WILMORE, PA.—Application will be made in the near future for a charter for a new telephone company, which is planning to construct a telephone line connecting Wilmore with Elton, Beaverdale, Summerhill and other towns in this vicinity. The capital stock of the company will be placed at $5,000 and the officers will be: Lyman Sherbine, president; S. W. Crum, secretary, and C. T. Settlemeyer, treasurer.

ABBEVILLE, S. C.—It is reported that the city has decided to purchase and rebuild the electric plant of the Abbeville Electric Light & Power Company, for $8,128, and will rebuild the plant at a cost of about $9,000. The franchise of the company was previously purchased for $3,000. S. M. Orr, city electrician, will have charge of the work.

BATESBURG, S. C.—Plans are being considered by E. F. Strother for the development of a water power and construction of an electric plant and transmission line. The plant will be located on the Southern Railway, nine miles south of Batesburg.

ROCK HILL, S. C.—The main building for the Womojo Yarn Mills has been completed. The mill will have a capacity of 10,000 spindles and the machinery will be operated by individual electric motors. W. W. Moore is president of the company.

ABERDEEN, S. D.—G. B. Coats, of Mobridge, is reported to have applied for a franchise to construct and operate an electric light plant in Aberdeen. R. F. Wherland is also reported to have applied to the City Council for a franchise to construct and operate an electric light plant in this city.

HURON, S. D.—Work will soon commence on the construction of the new electric light and gas plant of the Mitchell Power Company, which will be located about a half mile from the present plant. Entire new machinery will be purchased for the electric light plant and the coal gas plant will take the place of the acetylene gas plant installed some years ago.

BROWNWOOD, TEX.—The City Council has granted a franchise to W. S. Walker, of Granbury, Tex., to build and operate a street railway system in Brownwood.

CLEBURNE, TEX.—J. H. Ransome, who recently obtained a franchise from the City Council for a street railway, has leased a tract of land about 3½ miles north of Cleburne, where a park will be established, and proposes to extend the street railway system to the same.

CUERO, TEX.—It is reported that N. M. Ratcliff has purchased the dam and transmission lines of the Buchel Electric Company and has commenced work on the reconstruction of the electric power plant, which was recently destroyed by fire.

DALLAS, TEX.—The Dallas Interurban Electric Railway Company has accepted the terms of the resolution of the Dallas County Commissioners granting the company permission to construct an electric railway along the West Dallas Pike, thence along the Beckley Road to the northern limits of the city.

DENISON, TEX.—The Denison County Telephone Company is making arrangements to install a new telephone system, the cost of which is estimated at $75,000.

EAGLE PASS, TEX.—J. K. Wilson and E. T. Rucker are interested in a project to organize a company to establish an independent telephone system for Eagle Pass. The company will be capitalized at $30,000.

EL PASO, TEX.—The New Mexico Power Company is reported to have acquired about 4½ miles of land along the Penasco River, southeast of Cloudcroft, where the water will be diverted to Cox Canyon by a dam, from which the water will be taken in a ditch along the foothills to a power plant about three miles from Mayhill, about 18 miles from Cloudcroft. It is proposed to develop about 2000 hp, which will be transmitted to El Paso, Tex.; Jarilla, Alamogordo and Orogrande, Mex., where it will be utilized for lighting and power purposes. The cost of the plant is estimated at $500,000. E. Krause and W. E. Fletcher, of El Paso, are the promoters of the project.

FLORESVILLE, TEX.—Application has been made by F. Largen for a franchise to construct an electric light plant in Floresville.

SWEETWATER, TEX.—A company has been organized to costruct a water, ice, light and power plant in Sweetwater. A. H. Place, of Kansas City, Mo., hydraulic and civil engineer, has the contract for the construction of the plant. Burns & McDonnell, of Kansas City, Mo., will supervise the work. R. L. McCauley is president of the company.

OGDEN, UTAH.—The Ogden Rapid Transit Company has filed an amendment to its articles of incorporation, increasing its capital stock from $100,000 to $500,000.

BRATTLEBORO, VT.—The Twin State Gas & Electric Company has awarded a contract for reconstructing the foundations of the engines and building its steam power station to J. C. Pellett & Sons. The company is also rebuilding the intake at its water power station at Drummertown, Vt., eight miles north of Brattleboro.

MONTPELIER, VT.—Owing to the continued drought the plant of the Consolidated Lighting Company on the Winooski River has been forced to shut down entirely.

BRIDGEWATER, VA.—The Grattan water power on North River has been purchased by J. S. Dovel, of Bridgewater and Charles W. Bowman, who propose to develop the same and erect a power plant with an output of about 150 hp. The cost of the plant is estimated at $18,000.

DANVILLE, VA.—The City Council has appropriated $22,000 for improvements to the municipal electric light plant, which will include the installation of an additional boiler, a 500-kw steam turbo generator set, etc. Frank Talbot is superintendent of the water, gas and electric light department.

FREDERICKSBURG, VA.—Plans have been completed by William C. Whitner, hydraulic engineer of the Virginia Passenger & Power Company, and president of the Fredericksburg Power Company, for the construction of a dam across the Rappahannock River, about two miles above Fredericksburg, where it is estimated that 8000 hp can be developed.

ROANOKE, VA.—Announcement has been made that interests connected with the Roanoke Traction & Light Company have purchased the stock and bonds of the Roanoke Water Power Company and the James River Water Power Company. It is said that these properties, with those of the Roanoke Railway & Electric Company and the Roanoke Heat, Light & Electric Company, will be merged into a holding company, which will be chartered under the name of the Roanoke Traction & Light Company.

SALEM, VA.—A franchise has been granted by the town of Salem to the Roanoke Railway & Electric Company to extend its railway on Main Street to Lake Spring, a distance of 1 mile. J. W. Hancock, of Roanoke, Va., is general manager.

SOUTH NORFOLK, VA.—Arrangements are being made by the Planters' Telephone Company to construct a telephone system between Great Bridge and South Norfolk, Va.

OLYMPIA, WASH.—The City Council has granted the Olympia Light & Power Company a franchise to construct and operate a street railway from the intersection of Main and Third Streets west to the Government waterway.

SPOKANE, WASH.—Application has been filed with the Board of County Commissioners by the Spokane & Inland Empire Railroad Company for a franchise to extend its railway on First avenue one mile and a quarter east of the city limits. This is to be an extension of the new railway which is to pass the fair grounds.

TACOMA, WASH.—The fire and water committee has recommended to the City Council that plans drawn for a substation in which the electrical apparatus now stored at the plant of the Seattle-Tacoma Power Company will be installed, be changed to accommodate the present needs of the city, and recommends that the Commissioner of Public Works be instructed to call for bids for construction of the same after the plans have been approved by Frank L. Davis, city engineer.

VANCOUVER, WASH.—Arrangements have been made between the Portland Railway, Light & Power Company and the Vancouver Traction Company whereby the Portland company will furnish electircal energy to operate the new Vancouver railway for a period of one year, beginning Sept. 1.

WALLA WALLA, WASH.—The Washington & Oregon Traction Company has been granted a franchise to construct a street railway system in Walla Walla. The company proposes to build a railway south of Walla Walla and may extend the system to Pendleton.

WENATCHEE, WASH.—The Entait Power Company, of Entait, has applied to the City Council for a franchise to enter the city.

KAUKAUNA, WIS.—It is reported that the Kaukauna Gas, Electric Light & Power Company has leased the new electric power plant of the Green Bay & Mississippi Canal Company, which will give the Kaukauna company 2500 additional horse-power, part of which will be used by the Union Bag & Paper Company and the Thilmany Paper & Pulp Company to operate their plants by electricity.

LAKE GENEVA, WIS.—The Milwaukee Light, Heat & Traction Company has filed a petition with the State Railroad Commission at Madison, Wis., asking for a certificate of necessity and convenience for the construction of its electric railway from Waterford to Lake Geneva.

MADISON, WIS.—The contract for electric light fixtures for the new capitol building is reported to have been awarded to the Mitchell-Vance Electric Company, of New York, N. Y.

PORT WASHINGTON, WIS.—The City Council has awarded contracts for the construction of a municipal electric light plant and water works system as follows: For engines and condensers, to the Nordberg Manufacturing Company, of Milwaukee, Wis., for $10,170; for electrical machinery, to the Fort Wayne Electric Company, of Fort Wayne, Ind., for $3,662; Joseph Ubfink, of Port Washington, Wis., for construction of addition of power house and chimney, for $5,829. Contract for boilers has not yet been awarded. W. G. Kirchoffer, of Madison, Wis., is consulting engineer.

FERNIE, B. C., CAN.—At the recent fire which destroyed the entire city the electric lighting plant and system was also destroyed. The Crow's Nest Electric Light & Power Company, which owned the plant, has decided not to rebuild and has offered to sell out its franchises to the city. Arrangements are now being made to put a by-law before the ratepayers to provide sufficient money to rebuild and operate the system as a municipal enterprise. For further information address W. W. Tuttle, mayor.

BOISSEVAIN, MAN., CAN.—Sealed tenders will be received by G. C. Smith, town clerk, until noon, Sept. 23 for equipment for a municipal electric lighting plant. Alternative tenders will be received for either a gas producer or steam plant. Plans and specifications may be seen at the municipal offices here and also at the offices of W. E. Skinner, consulting engineer, Somerset Building, Winnipeg, Man.

GLACE BAY, N. S., CAN.—The town is installing 400 meters in connection with the municipal electric light plant, and is also adding about three miles of transmission lines to the system. F. W. Frizzell is manager.

KENORA, ONT., CAN.—The town has disposed of $30,000 power development bonds, which will enable the town to carry out its power development scheme.

LEAMINGTON, ONT., CAN.—The local electric light plant, owned by Messrs. Storrs, Reid and Post, has been purchased by Detroit, Mich., capitalists. The price paid for the plant is said to have been $25,000. The new owners contemplate making extensive improvements to the system.

PORT ARTHUR, ONT., CAN.—A contract has been awarded to Stewart & Hewittson for a power dam at Current River Park, for $35,000. This dam will replace the one partially destroyed last spring. J. McTeigue is city clerk.

TORONTO, ONT., CAN.—Bids will be received until Sept. 28: (a) For furnishing and erecting 63,500-volt single-phase, or 110,000-volt, three-phase transformers for operation on the Hydro-Electric Commission's 110,000-volt transmission system; (b) For furnishing and erecting compiete the switching and indicating apparatus for the 110,000-volt transfomer stations as follows: Niagara Falls, step-up transformer station; Toronto, London, Dundas, Guelph, Preston, Berlin, Stratford, St. Marys, Woodstock, Brantford and St. Thomas, step-down transformer stations, according to plans and specifications, which may be obtained at the office of the Hydro-Electric Commission, Continental Life Building, Toronto, Ont. Adam Beck is chairman of the commission.

ESTEVAN, SASK., CAN.—A company is being organized to the south of this town to construct a rural telephone system with 11 miles of wires to be strung this fall and more added in the spring. Connection will be made with this town by a long distance line. W. C. Howland, Estevan, Sask., is interested in the enterprise.

ATOTONILCO, MEX.—Steps have been taken to install a hydro-electric plant at the Faretan waterfall near the town of Atotonilco, State

of Jalisco, by the Atotonilco Light & Power Company. It is proposed to build transmission lines to the town of Atotonilco and other places in that district. Enrique Alvarez del Gastillo is president.

AUTLAN, MEX.—S. Fred Ossolinski and associates, who own the Ojo Verde copper mines near Autlan, State of Jalisco, recently completed the survey for a series of hydro-electric plants which they have planned to install on the Ojo Verde River, where an initial plant of 500 hp will be installed and the water carried further down the river to the site of the second plant, where about 500 hp will be developed. The energy will be utilized in the mines and mills in that district.

CHIHUAHUA, MEX.—It is reported that the Compania Agricola y de Fuerza Electrica will soon begin the construction of a large hydro-electric plant on the Conchos River, in the State of Chihuahua. The plans call for the installation of a 28,000-hp plant and the building of transmission lines to the cities of Chihuahua, Parral and other industrial centers in that State. A large dam will be built across the Conchos River to store water for power purposes.

LA JOYA, MEX.—A syndicate of Canadians and Germans are arranging to install a hydro-electric plant at La Joya, also on the Conchos River, for the purpose of generating electricity, which will be transmitted to a number of towns in the State of Chihuahua. It is planned to develop about 12,000 hp at this plant.

MEXICO CITY, MEX.—Preliminary work for the installation of a new hydro-electric plant for furnishing electricity for lamps and motors in the City of Mexico has been commenced by Veyan, Jean & Company, who have obtained a concession from the Federal Government for the project. The initial power for the proposed plant will be obtained from the Alameda River and a canal is now being built to divert water from that stream for operating the hydro-electric plant. It is planned to develop about 8000 hp. The transmission line will be about 45 miles long.

MEXICO CITY, MEX.—The Tri-State Development Company has purchased the Federal concession which was granted to J. F. O'Gorman for the installation of a large hydro-electric plant on the Fuerte River, in the State of Sinaloa. Work will soon begin on the construction of the plant, for which surveys and plans have been made by A. M. Nelson and submitted to the Government for approval. The plans call for the development of 15,000 hp at lowest water, and include the construction of a dam of reinforced concrete 1000 ft. long and a power house. The proposed plant will furnish electricity for the different mining camps in that part of Mexico. The Kansas City, Mexico & Orient Railroad will pass close to the site of the plant, and it is reported that that road may use electrical power to operate its trains over the mountain division.

MEXICO CITY, MEX.—The Mexican Government has granted a large number of concessions recently for the installation of hydro-electric plants in different parts of the country, among the more important ones being the following: To Gonzales Carranza, for a plant on the Navosaigame River, State of Chihuahua, the energy to be utilized in the mines of Roncesvalles y Anexas; to Manuel Gomez Pezuela and associates, for a plant on the Amacusac River, State of Morelos; to Jesus Trillo, for a plant on the Bovos River, State of Vera Cruz; to Pascual Trulls, for a plant on the Tamaom River, State of San Luis Potosi; to Robert L. Kayser, representing the Tezuitlan Copper Company, for a plant on the Atoyac River, State of Oaxaca; to Miguel Bolanos Cacho, for a plant on the Coxapa River, State of Puebla; to Juan Alonzo, for a plant on the Molino de Calderon River, State of Mexico; to Fernando Duret, for a plant on the Balsas River, State of Guerrero; to W. O. Temple, for a plant on the Mayo River, State of Sonora, and to Jose F. Buel, for a plant on the Ameca River, State of Jalisco.

New Incorporations.

BEEBE, ARK.—The Beebe Light & Power Company has been incorporated, with a capital stock of $10,000. The officers of the company are: J. S. Smith, president; M. Strickland, vice-president, and E. Roberts, secretary and treasurer.

PAONIA, CAL.—The Paonia Electric Light & Power Company has been chartered, with a capital stock of $10,000, by W. T. Baetjer, C. C. Hawkins and R. J. Huff, all of Paonia.

SAN FRANCISCO, CAL.—The Napa & Lakeport Railroad Company has been incorporated to build an electric railway from Napa to Lakeport, a distance of about 90 miles. The capital stock of the company is placed at $2,000,000, and the directors are: G. W. Conlisk, of San Francisco, Cal., treasurer; W. H. Rank, of Alameda, Cal.; R. A. Morton, of San Francisco, Cal.

PABLO BEACH, FLA.—The Pablo Beach Development & Power Company has been incorporated, with a capital stock of $60,000, and the following-named officers: C. H. Mann, president; Oscar Seewald, vice-president; J. Denham Bird, secretary and treasurer.

CHATSWORTH, ILL.—The Chatsworth Electric Company has been incorporated, with a capital stock of $25,000, by L. A. Walter, J. B. Grotevant and G. W. McCabe, all of Chatsworth, Ill. The company proposes to furnish electricity for light, heat and power.

CHICAGO, ILL.—The Chicago, Wheaton & Western Railway Company has been chartered to build an electric railway touching the region north of Wheaton, Ill., and will connect the Aurora, Elgin & Chicago Railroad with West Chicago. The company is capitalized at $10,000, and the incorporators are: J. Sydney Condit, J. Percy Strickland, D. W. Peters, R. B. Tabor and H. C. Wood, all of Chicago.

EVANSVILLE, IND.—The Evansville & Eastern Railway Company has been incorporated, with a capital stock of $10,000, by John C. Lake, of Lake, Ind.; Marcus S. Sonntag, W. H. McCurdy, Albert F. Karges, William A. K. Koch and C. H. Battin, of Evansville, Ind. The company proposes to construct an electric railway from Rockport to New Albany, Ind., thence to Louisville, Ky., across the Ohio River.

HILLSDALE, IND.—The Hillsdale Telephone Company has been organized with D. B. Highfill as president. The directors of the company will soon be in the market for material and equipment for the construction of a new telephone plant.

INDIANAPOLIS, IND.—Articles of incorporation have been field for the Logansport, Frankfort & Indianapolis Traction Company, with a capital stock of $25,000, to construct an electric railway from Frankfort to Logansport. The incorporators are: Samuel H. Blakeslee and Allen G. Barone, of Cleveland, Ohio, and Fred Cook, of Indianapolis, Ind.

INDIANAPOLIS, IND.—The Oregon Water & Power Company has filed articles of incorporation with the Secretary of State. The company is composed of Indianapolis capitalists who propose to develop water power for the generation of electricity in the State of Oregon to supply cities and towns with electricity for light, heat and power. The main office will be located in Indianapolis, Ind. The directors are F. M. Fauvre, William E. English and Monroe George.

JONESVILLE, IND.—The Jonesville Mutual Telephone Company has been incorporated, with a capital stock of $15,000. The company proposes to install a new plant with a modern exchange. Thomas J. Kobbe is president and W. T. Irvin secretary.

SEYMOUR, IND.—The Seymour & Brownstown Construction Company has been organized to construct an electric railway between Seymour and Brownstown, a distance of 12 miles. Indianapolis and Marion men are interested with local men in the enterprise.

WHITEWATER, KAN.—The Whitewater Telephone Company has been incorporated, with a capital stock of $10,000.

FEDERALSBURG, MD.—The Idlewild Electric Light Company, which was recently granted a charter has been organized and the following directors elected: John F. Disharoon, J. B. Wright, E. E. Goslin, Thomas H. Chambers, C. B. Wright, Henry Disharoon, W. R. Breding, of Federalsburg; Hazleton Joyce, of Cambridge, and B. Cunningham, of Virginia.

SAGINAW, MICH.—The Saginaw & Flint Railway Company has been incorporated and has purchased the street railway system formerly owned by the Detroit, Flint & Saginaw Railway Company. Work will commence immediately on the construction of an electric railway to Flint. The officers of the company are: A. J. Groesbeck, president; Mark Mitshkun, secretary, and N. A. Tabor, treasurer. The principal office will be in Detroit, Mich.

PLATTSBURG, MISS.—The Plattsburg Telephone Company has been chartered, with a capital stock of $10,000, by H. M. Woodall, J. L. Lee and others.

DESLOGE, MO.—Articles of incorporation have been filed for the Lead Belt Telephone Company, with a capital stock of $20,000, by A. C. Mackley, J. L. Goff, W. P. Blessing and others.

BILLINGS, MONT.—Articles of incorporation have been filed for the Billings & Cooke City Electric Railway Company, with a capital stock of $5,000,000, by J. B. Clayberg, of Helena, Mont.; M. E. Estep, of Chicago, Ill.; E. M. Hosky, Helena, Mont.; George E. Savage, of Butte, Mont.; Thomas Harney, Galena, Ill.; A. L. Babcock, B. G. Shorey and Theodore Martin, of Billings, Mont.

GREELEY, NEB.—The Central Telephone Company has been incorporated, with a capital stock of $50,000, by D. B. Huff, W. E. Reed and others.

HOLDREDGE, NEB.—The Western Central Railroad Company has been incorporated to build an electric railway from Holdredge to a point a few miles west of Kearney, for which the company is now engaged in making surveys and securing the right-of-way. The company is capitalized at $250,000, and the directors are T. E. Brady, Charles Stanton, J. G. Burlingham, E. O. Carlson and S. C. Nelson, all of Omaha, Neb.

NEW CASTLE, NEB.—The Grand Ridge Telephone Company has been incorporated, with a capital stock of $2,000, by Jacob Nelson, O. G. Nelson and E. T. Rohar.

JERSEY CITY, N. J.—The Billings Mutual Telephone Company has been incorporated with a capital stock of $500,000 by P. B. Moss, George M. Hays, J. Nevin Perry, of Billings, Mont., and Samuel S. Moore, of Jersey City, N. J.

PATERSON, N. J.—Articles of incorporation have been filed for the New Jersey Rapid Transit Company, with a capital stock of $1,000,000, by Thomas J. Maloney, of Jersey City, N. J.; Henry M. Parmaled, Herbert Bogart, Charles D. Cook and Guy H. Pierce, all of Paterson, N. J.; M. R. McAdoo, of Montclair, N. J., and George M. Dunlap, of Spring Valley, N. Y. The company proposes to construct a railway from Paterson to Suffern, N. Y., a distance of about 14 miles.

YONKERS, N. Y.—The Westchester County Automatic Telephone Company has been incorporated with a capital stock of $100,000 by Frederick Hughes, Helen Degnon, Joseph L. Abrahams, of Yonkers, and others.

New Industrial Companies.

THE ELWELL RUBBER & INSULATION COMPANY, of Trenton, N. J., has been chartered, with a capital stock of $10,000, by Russell T. Elwell, Kenneth R. Elwell and Henry Smith. The company proposes to manufacture electrical insulation goods.

THE SOUTHERN LIGHT IMPROVEMENT COMPANY, of Greensboro, N. C., with capital stock of $10,000, has applied for a charter to manufacture and sell electrical apparatus, fixtures, etc. Chas. L. Van Noppen and others are the incorporators.

THE MALNGEN ENGINE COMPANY, of Kittery, Maine, has been incorporated, with a capital stock of $4,000,000, to manufacture and sell engines and boilers. The officers are: H. Mitchell, president, and M. L. Carlin, treasurer, both of Kittery, Maine.

THE CHESAPEAKE GAS ENGINE CORPORATION, of Phoebus, Va., has been incorporated, with a capital stock of $50,000, for the purpose of manufacturing and repairing gas engines, etc. Richard Armstrong, of Hampton, Va., is president and A. F. Bowen, of Newport News, Va., secretary and treasurer.

THE INDEPENDENT CONSTRUCTION COMPANY, of Terre Haute, Ind., has been incorporated, with a capital of $150,000. The company proposes to do a general contracting and construction business, making a specialty of building interurban lines. George C. Foulkes, Robert Herkimer and W. H. Harris are the directors.

Personals.

MR. GEORGE P. ZWERNER has resigned as superintendent of the Marysville Light & Water Company, of Marysville, Ohio.

MR. W. E. GILMORE, who was formerly so prominently identified with Edison manufacturing interests, has just returned from Europe with his family, after a trip thither in search of rest and health. His plans for the future have not been announced.

MR. S. R. FARIS, who for several years has traveled for the Western Electric Company in the South and Southwest, and who spent recently some time at Mexico City for that company, has resigned. He will sail for Europe Sept. 19 and return about Jan. 1.

MR. WILLIAM H. McKINLOCK, president of the Metropolitan Electrical Supply Company, has been spending some days in New York City among old electrical friends, and also visiting Mr. C. E. Murray, of the Crescent Insulated Wire & Cable Company, at his summer home, Sea Girt, N. J.

MR. G. MARCONI arrived last week in New York from London and proceeded almost immediately to Glace Bay. There are rumors of a Marconi oceanic wireless station for New York City, which would seem to be in some respects a very desirable point of communication. Mr. Marconi is to return shortly to this city.

DR. N. M. HOPKINS, the well-known consulting electrical engineer, of Washington, D. C., has another "detective" story in *Lippincott's Magazine* for September. All of these successful and ingenious romances have been based on scientific fact, such as the Roentgen ray or some new point in chemistry. The present story deals with a quite unsuspected use of the wireless coherer in the perpetration of a murder.

MR. FRANK A. CHAPIN.—Mrs. Anna C. Chapin, of Ludlow Centre, near Springfield, Mass., is very desirous of obtaining news of her son, Mr. Frank A. Chapin, an "electrician," whom she has not seen for three years, when he was employed in Boston and boarded at Newton, Mass. Since he left home his father and sister have died, and the mother is now living alone. Our readers are requested to furnish any news or clue that may be useful.

MR. GEORGE H. GUY, secretary of the New York Electrical Society, has in the September *Review of Reviews* a very able and interesting survey of aeronautics, as the art stands at the present time. Mr. Guy knows personally most of the prominent American aeronauts, and the article gives first hand data from them. It is profusely illustrated and is altogether the best all-around treatment that the subject has had in a long time. Mr. Guy gives in the article some statements from Mr. Edison as to his plan for a helicopter, accompanied by a sketch which he made to elucidate the subject. The article occupies nearly 14 pages of the magazine.

MR. HORATIO A. FOSTER has resigned from the engineering force of Mr. L. B. Stillwell and has become connected with the Evaluation Department of the Public Service Commission, First District, New York, where he will be engaged upon the appraisal of the street railway systems of New York, which is to be conducted by Mr. B. J. Arnold. For the last year and a half Mr. Foster has been resident engineer in Baltimore for Mr. Stillwell, and as such has had charge of the reconstruction of the power station of the United Railways & Electric Company of that city and other work upon which Mr. Stillwell has been engaged under his contract with the United Railways & Electric Company.

MR. EMILE BERLINER, inventor of the famous telephone transmitter bearing his name, has, like so many other electrical engineers, taken up the new art of aeronautics and is working out a machine which is promised to embody many departures from present aeroplane construction and to be a radical advance, just as was his "talking machine," now so widely used. He has constructed a helicopter "heavier than air" type of flying machine, which he has named the "aeromobile." Experiments with this machine, which is entirely of steel and aluminum, show that with a motor weighing 100 lb. a weight of 360 lb. can be lifted, and a speed of 70 to 100 miles per hour with it is considered possible.

Business Notes.

DOSSERT & COMPANY, 242 West Forty-first Street, New York, have received an order for several hundred solderless lugs from the Trumbull Electric Manufacturing Company, of Plainville, Conn., for use on the panel and switchboards to be installed in the new Senate Building, Washington, D. C. The lugs range in size from No. 6 to 400,000 circ. mil., and many of them are of special pattern in regard to the contact surface.

U. T. HUNGERFORD BRASS & COPPER COMPANY, 397 Pearl Street, New York, is paying particular attention to the manufacture of drawn copper bars, rectangular, round and irregular in shape. Consumers of this material can find it in stock, accurate in size and of the highest conductivity, in the warehouses of this firm without having to wait for mill manufacture. The Hungerford catalog contains full information of the large stock carried.

S. K. ELLIOTT ELECTRIC COMPANY.—Mr. S. K. Elliott announces the formation of the above-named concern, which takes over his business, with headquarters at 322-8 Champlain Avenue, N. W., Cleveland, Ohio. The old business was known as Elliott Brothers Electric Company, and the new firm will follow along the same lines, but with larger equipment, in handling supplies for central station and electric railway plants, isolated plants, etc., and in making repairs to electrical apparatus. The officers are: S. K. Elliott, president and general manager; L. L. Myers, vice-president; C. P. Billings, secretary; C. W. Elliott, treasurer.

HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, states that its main factory and stock were seriously damaged by the fire of Aug. 28, but that it is in a position to take care of all orders. The loss is estimated at $250,000, partially covered by insurance. As the fire occurred so late in the month practically all the August orders had been shipped. All orders in the Eastern territory will continue to be filled from the stock of fuse wire, fuse links, telephone fuses, conduit boxes, sectional switch boxes, portable lamp guards, wire connectors, cleats, etc., carried by the Harvard Electric Company, 136 Liberty St., New York City. The Chicago factory will commence work on Sept. 9 with sufficient force to fill all orders promptly, and the Harvard Electric Company has already perfected plans for a larger and more thoroughly equipped building to be completed before November.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 8, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

897,866. SIGNALING APPARATUS; G. F. Atwood, East Orange, N. J. App. filed Feb. 26, 1906. Electric signaling apparatus particularly adapted to a telephone set for use under conditions where it is exposed to unfavorable weather conditions, such as police boxes. Relates to detail features of construction and includes batteries and magneto generator.

897,906. LIGHTNING ARRESTER; F. P. H. Knight, Keokuk, Ia. App. filed June 28, 1907. A form of lightning arrester including a cartridge fuse and spark-gap established between elongated spheroidal bodies. The spark-gap is bridged by a coarse wire inductance surrounding a magnetic core connected with one of the spheroidal bodies.

897,938. PROCESS FOR THE MANUFACTURE OF CEMENT; W. L. Snyder, Nazareth, Pa. App. filed March 11, 1907. The process of calcination, which consists in subjecting suitable material to a series of electrically generated heats and the employment therewith of an air current through the successive heats from the final to the initial heat.

897,950. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Jan. 20, 1908. In combination an alternating current circuit, a direct current circuit, transforming apparatus including a rotary converter connected between them, and means responsive to changes of electrical condition on the alternating current circuit and adapted to vary the distribution of field flux around the periphery of the converter armature.

897,960. ELECTRIC-ARC LAMP; P. M. Capitaine, Les Lilas, France. App. filed Nov. 11, 1907. An electric arc lamp having a regulating system designed to be particularly sensitive, to secure a downward feed of the carbons. Makes use of a reel driven by a reducing gear connection from an operating solenoid.

897,965. SYSTEM FOR TRANSMITTING ELECTRIC CURRENTS TO CARS; John J. Eagan, San Francisco, Cal. App. filed Oct. 18, 1905. An overhead system for transmitting electric currents to trains of cars, and including strips extending lengthwise along the car roofs so as to be engaged by depending spring plates on spaced supporting poles along the roadway.

897,981. DEVICE FOR PRODUCING INTERMITTING LIGHT; J. C. F. Jürgens, Hamburg, Germany. App. filed Sept. 10, 1907. A device for producing intermitting light, comprising a gas-conduit having a valve and cams to open and close the valve, in combination with a clock mechanism to operate the cams.

897,997. RAIL-BOND; R. J. Ostick, Covington, Ky. App. filed May 9, 1907. A means for frictionally clamping a rail bond to the bottom surface of two adjoining rails so as to lock the rails together against lateral displacement. Has a two part box, embracing the rail bases and bolted together by transversely extending bolts.

898,030. SYSTEM OF REGULATION; J. Bijur, New York, N. Y. App. filed April 4, 1906. A system of electric regulation including a source of current supply and a booster provided with an auxiliary field for compensating for armature reactions and a main field for varying the direction and amount of voltage of the booster in accordance with changes on the work circuit.

898,052. ELECTRIC-ARC LAMP; Robert E. Leve, of New York. App. filed Jan. 22, 1908. Has a pair of downwardly convergent carbon electrodes for a flaming arc lamp and adapted to be lowered by cord connections from a rotatable reel.

898,055. ELECTRIC BATTERY; William MacMillan, of New York. App. filed Aug. 18, 1902. A battery having positive and negative elements and a covering for the elements for preventing the deposit of sediment or products of decomposition upon the elements, so as to prevent an increased internal resistance.

898,058. MEANS FOR REGULATING DYNAMO-ELECTRIC MACHINES; W. L. Merrill, of Schenectady, N. Y. App. filed Feb. 20, 1906. A system of operating motors at a constant speed regardless of load by controlling the field excitation of the current supplying generator. The fields are compounded in a special way so as to compensate for line losses, armature reactions, etc.

898,061. FUSE-BOX; Harry P. Moore, Newburyport, Mass. App. filed April 8, 1907. A form of fuse adapted to be removed and replaced with one hand and particularly adapted to the use of linemen, who frequently have only one hand available for this work.

898,063. HAIR CRIMPER AND CURLER; Paul E. Oswald, Los Angeles, Cal. App. filed Aug. 22, 1907. In place of the usual curling tongs, patentee makes use of a structure having a resistance element embodied in a hollow rod. An enamel covered resistance wire is made use of as the heating element.

898,073. APPARATUS FOR SPEECH TRANSMISSION; Herbert E. Shreeve, Wyoming, N. J. In a telephone apparatus, a transmitting element comprising a casing, a vibratory electrode, and means for supporting the electrode upon the casing, both electrode and supporting means being capable of free lateral expansion.

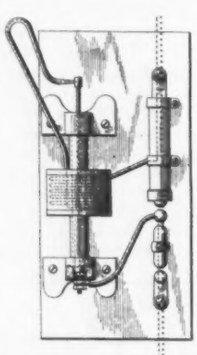
898,076. SIGNAL-BOX; Nathan H. Suren, Needham, Mass. App. filed Jan. 5, 1907. A signal box having a glass plate enclosing an abnormally disposed actuating lever which may be moved into its normal condition after the glass plate has been removed.

898,083. ELECTRIC-LIGHT FIXTURE: William Amstalden, Amador City, Cal. App. filed Dec. 31, 1907. A take up for flexible cord connections including a spring reel having a form of detent analogous to a shade roller.

898,086. MULTIPLE ELECTRIC FUSE CUT-OUT; Wilhelm Boehm, Berlin-Charlottenburg, Germany. App. filed June 8, 1907. A supply of fuse wire is kept on a reel in the socket, and a portion may be unwound from time to time and included in the circuit as required.

898,095. SIGNAL-BOX; F. W. Cole, Newton, Mass. App. filed July 10, 1906. A signal-box having a telephone and a signalling train, and a means for arresting the train at an intermediate part of its operation, while the telephone is included. Adapted for use in a police signal system for transmitting different kinds of calls automatically.

898,097. TERMINAL FOR ELECTRICAL CABLES; Charles W. Davis, Edgeworth, Pa. App. filed Dec. 23, 1907. An outlet box for joining the conductors of an underground conduit to an over-head system, and adapted to afford adequate protection against weather conditions. The circuits are completed through rods embedded in insulators which project beneath an insulating ledge, where the connection to the over-head wires is made.



897,906.—Lightning Arrester.

898,104. CIRCUIT-CLOSER FOR CALL-BELLS; Robert Henderson, of the United States Navy. App. filed June 4, 1906. A form of circuit closer having a ball depending from a cord, and which depletes the circuit when the ball is pulled.

898,133. APPARATUS FOR PRODUCING VOLTAIC HIGH-CURRENT ARCS; Harry Pauling, Gelsenkirchen, Germany. App. filed July 29, 1907. A means for establishing comparatively long arcs by the combined use of a magnetic field and a current of gas.

898,173. PROCESS OF PRODUCING FERRO-ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed May 25, 1908. The process of producing low ferroalloys which consist in electrically smelting a charge containing a refractory oxid ore, a source of iron and the carbid, the carbid being present in proportion to yield a metallic product low in carbon.

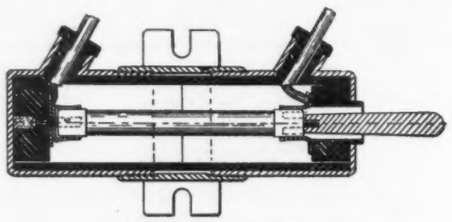
898,182. JUNCTION-BOX FOR ELECTRICAL CONDUCTORS; James F. Burns, Philadelphia, Pa. App. filed Jan. 17, 1908. Has a threaded sleeve at each end to receive the conduit pipe and intermediate rectangular portion with one corner cut away so as to receive one or more bushings in water-tight relation.

898,189. ELECTRODEPOSITION OF ALLOYS; Sherard Osborn Cowper-Coles, London, Eng. App. filed Aug. 2, 1907. A method of depositing alloys, which consists of employing an anode of the alloy to be deposited and an anode of each of the metals composing the alloy.

898,195. SUPERVISORY SYSTEM FOR TELEPHONE LINES; William W. Dean, Chicago, Ill. App. filed Oct. 31, 1903. In a telephone system, the combination with telephone lines, of a cord-circuit to establish connections for conversation with said lines, said cord circuit having two strands included, one in each side of the talking circuit, a non-inductive supervisory signal in one of the strands, and a supervisory relay in the opposite strand to deprive said signal of operating current.

898,197. WIRELESS-TELEGRAPH APPARATUS; Halsey Dunwoody, of the United States Army. App. filed May 21, 1907. A portable wireless apparatus adapted to send and receive messages for distances of over one hundred miles, and which is portable; includes complete features of transmitter and aerial.

898,216. ELECTRIC-RAILWAY CONDUIT; Elmer E. Granger, Chicago, Ill. App. filed Aug. 4, 1906. The third rail is sectionally electrofied while a train is passing by the use of a flexible conductor



898,061.—Fuse Box.

in a conduit beneath the track, and which is elevated by an electric magnet to complete circuits with contact plates during the passage of the train.

898,219. RAILWAY ELECTRIC SIGNALING; Job Hutchinson, New York, N. Y. App. filed May 10, 1905. Includes a third rail supply conductor having a cover movably mounted with relation to said supply conductor and signal conductor mounted on said cover.

898,220. CONTACT-RAIL FOR ELECTRIC RAILWAYS; Job Hutchinson, New York, N. Y. App. filed May 10, 1905. The contact rail is normally entirely enclosed by a cover depressed thereon by springs. The cover is elevated during the passage of the contact shoe by its engagement therewith.

898,221. RAILWAY ELECTRIC SIGNALING SYSTEM; Job Hutchinson, New York, N. Y. App. filed Jan. 2, 1906. A complete block signal system designed to present danger and caution signals and in which the giving of a false safety signal under any circumstances is prevented.

898,231. REFRIGERATOR; Joseph Ovila La Madeleine, Montreal, Quebec, Canada. App. filed May 23, 1907. An alarm for preventing overflow of drip pan in refrigerator; includes a float connected to an electric bell circuit.

898,324. ELECTRIC SIGNALING SYSTEM; Elmer R. Coe, Wilkinsburg, Pa. App. filed May 11, 1908. Has a transformer for impressing a signal current on the track rails, and a signal controlling relay having its energizing wire connected in series with the track and between the secondary winding of the transmitter and the track.

898,097.—Terminal.

898,346. APPARATUS FOR THE TREATMENT OF GASES; Sebastian Ziani de Ferranti, Grindleford, Eng. App. filed June 10, 1907. An apparatus for carrying out endothermic reactions. Has means for heating the gases to the reaction temperature, together with nozzle means for subsequently cooling the gases.

898,390. PROCESS OF CONCENTRATING NITROSULFURIC WASTE ACID; Harry Pauling, Gelenkirchen, Germany. App. filed Aug. 13, 1906. A process of regenerating the dilute nitric acid resulting from the manufacture of explosive substances.

898,391. CHANDELIER-HANGING DEVICE; Olof Peterson, De Kalb, Ill. App. filed Aug. 8, 1906. A flexibly suspended chandelier having a form of ball and socket connection, the circuit being established through contact plates.

898,404. PROCESS OF MAKING ARTICLES BY ELECTROPLATING; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed Nov. 3, 1906. A process of making a storage battery receptacle, which consists of electric-plating a coating of copper on a former, electroplating a nickel film on the copper and in electroplating an iron film on the nickel.